December 25, 1961

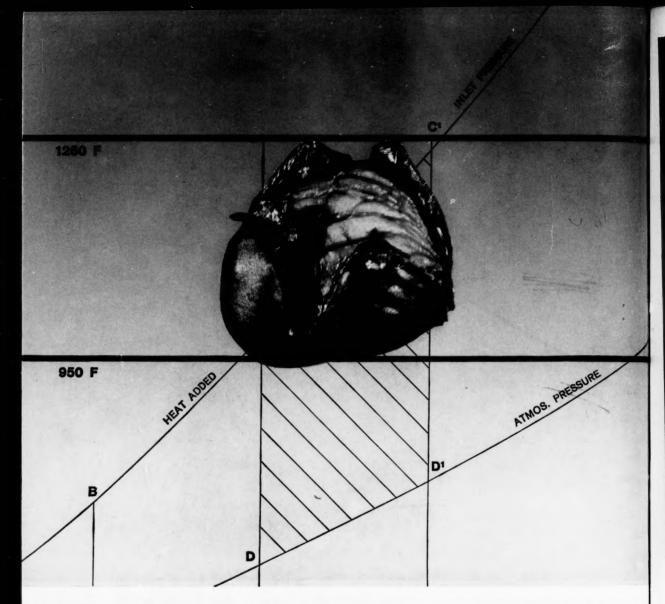
cGraw-Hill Publication / Published every-other-Mond Seventy-five cents

660

THE JOHN CREMAR LIBRARY

DEC 26 1961

Chemistry's Gift: Synthetic Gems



THE POWER RECOVERY "CHESTNUT"

or how to take power from 950F-1250F tail gas

A proven method for taking mechanical power from process tail gas below 950F is the turbine. Taking power from tail gas above this temperature has, in the past, been a power recovery "chestnut"—too hot to handle despite its desirability. But now, Worthington offers a Power Recovery turbine that can successfully pluck the meat from this very hot "chestnut."

The "meat" is extremely tasty. Frequently, if tail gas can be put to work at 1250F instead of 950F, as much as 12 to 15 per cent more power can be captured. In some installations, the heat exchangers that formerly handled the drop to 950F can be eliminated. In others, thermodynamic analysis will now show the feasibility of heating the gas to 1250F to get

maximum mechanical power recovery. In the past, use of Power Recovery turbines at the higher temperatures has been impractical. One major problem has been in mechanical design. Misalignment caused by excessive thermal expansion, higher temperature sealing, rotor construction, and forces imposed on the expander by inlet piping expansion and construction are all part of the problem. Today, Worthington has minimized them by creating a new design and using new materials.

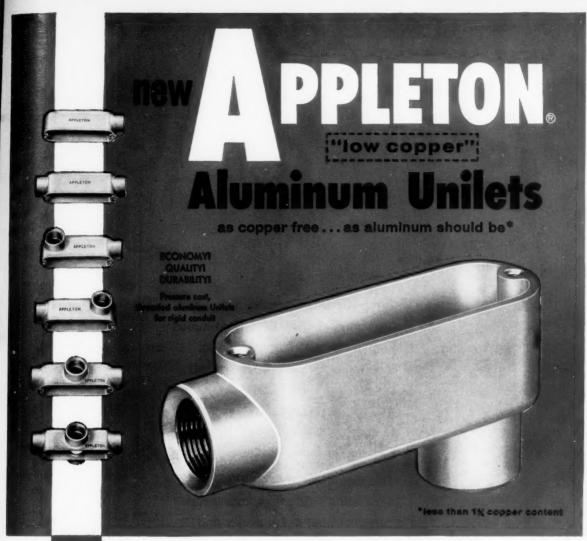
A second major problem area that Worthington has overcome is analysis of the gas itself. Most tail gases are mixtures and their behavior is not fully plotted at the temperatures involved. But the behavior must be known before the turbine can be

designed. Today, Worthington is ready to analyze the heat recovery potential of any gas or gas-steam mixture and to design a Power Recovery turbine to match.

If you would like to taste the meat of this power recovery chestnut, above or below 950F, write or call Worthington Corporation, Turbine Division, Dept. 48-14, Wellsville, N.Y.



PRODUCTS THAT WORK FOR YOUR PROFIT



Form 85 Unilets

The advantages of aluminum combined with Appleton manufacturing standards for dependable performance now make available a wide selection of rugged, serviceable pressure cast aluminum fittings to give you easier electrical installations . . . faster, more economical!

Your distributor has them now. The complete line includes seven of the most popular types in 1/2", 3/4" and 1" sizes to meet most job requirements. When you use them, you will agree . . . they are outstanding in every respect-from design to manufacturing excellence.

BEFORE YOU BUY OR SPECIFY ... CHECK THESE APPLETON QUALITY FEATURES

Easy to use-roomy . Lightweight-durable . Taper Tapped threading . Precision hub alignment . Chamfered hub edges • Pressure cast smoothness · Reinforced points of stress · Easy-to-read cast identification • Attractive, practical design • Low cost-high quality • Wide assortment of covers

Contact your distributor or write for bulletin No. AL 60. It includes details for the entire aluminum product line by Appleton: Form 85 and larger sizes in Form 35 Unilets, FS and JB fittings and V-51 lighting fixtures.

Sold through franchised distributors only

Explosion-Proof

Also manufacturers of

Covers, Switch Boxes

electric company

1701 Wellington Avenue, Chicago 13, Illinois

77

to

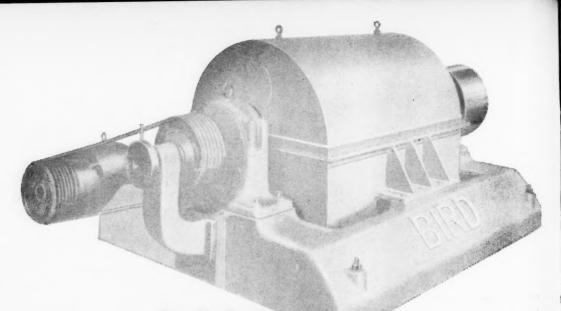
iny

n a

his

NC

0





Since The Dow Chemical Company ordered their first BIRD Continuous Centrifugal eighteen years ago, they've sent us twenty-six repeat orders. You'll find BIRDS on the job in Dow plants from Midland and Ludington, Michigan to Pittsburg, Cal., to Freeport, Texas.

This clean, dependable method of separating solids from liquids has demonstrated its efficiency and economy for many users.

Examine your own solid-liquid separating methods and equipment. The Bird Research and Development Center is prepared to supply the facts and figures.



BUILDERS OF THE COMPLETE LINE OF SOLID-LIQUID SEPARATING EQUIPMENT

Operators of the Bird Research and Development Center for pilot-scale testing to determine the correct equipment for the job. Yours to use.

Application Engineering Offices:

EVANSTON, ILL. • ATLANTA, GA. • HUNTINGTON, W. VA. • WALNUT CREEK, CALIF.

OTI

124

145

147

170

170

C

CHEMICAL December 25, 1961 ENGINEERING

CHEMICAL TECHNOLOGY FOR PROFIT-MINDED ENGINEERS

- 7 EDITORIAL
- 17 CHEMENTATOR
- 26 INDUSTRY & ECONOMIC NEWS

Flame-Grown Gem Stones Enjoy Broadened Use 26 Pigment Proves Its Rust-Fighting Properties Linde Joins Select Group of Award Winners 34 Equipment and Materials Vie for "Chem Show" Attention 38 CPI News Briefs 40

- 42 NEW CHEMICALS
- 48 NEW EQUIPMENT

Two Agitators on Same Shaft Stir Things Up 48 Little Centrifuge: Big Output 50 Equipment Cost Index 123

60 PROCESS FLOWSHEET

Attapulgite: 1 Process, 90+ Grades

67 FEATURE ARTICLES

Is Radiation Chemistry Practical? P. Y. Fena Using Ion-Exchange Resins and Membranes H. P. Gregor 73 Apply Fluidization to Gas Humidification N. Enstein Explosion Suppression: New Safety Tool C. B. Hammond 85

89 YOU AND YOUR JOB

Engineers Look for More Help in Finding New Jobs*

94 PLANT NOTEBOOK

Versatile Scrub Tower Removes Halogen Off-Gases J. Holmes

* FREE-For an extra copy of this article, Check Reader Service Card, p. 145.

104 CE COST FILE

Process-Vessel Protectors B. G. Liptak

108 CORROSION FORUM

Steel Tanks for Rocket Fuels J. Halbig

127 ANNUAL EDITORIAL INDEX

OTHER REGULAR FEATURES

5 HIGHLIGHTS

6 LETTERS: PRO & CON

119 CONVENTION CALENDAR

124 TECHNICAL BOOKSHELF

145 READER SERVICE POSTCARD

147 REPRINTS NOW AVAILABLE

148 MANUFACTURERS' LITERATURE 163 CLASSIFIED ADVERTISERS

170 INDEX OF ADVERTISERS

170 ADVERTISING REPRESENTATIVES

PRINT ORDER FOR THIS ISSUE 53,765 VOLUME 68, NUMBER 26

Chemical Engineering (with Chemical & Metallurgical Engineering) is published biweekly by McGraw-Hill Publishing Company, Inc., James H. McGraw-Hill Publishing Company, Inc., James H. Executive, Editorial, Circulation and Advertising Offices, 330 West 43nd St., New York 36, N. Y. Officers of the Publications Division: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director: Joseph H. Allen, Vice President and Editorial Director: Joseph H. Allen, Vice Tresident and Controller. Officers of the Corporation: Donald C. McGraw, President; Hulp J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Kelth Goodrich, Executive Vice Presidents; L. Kelth Goodrich, Executive Vice President; Allen, J. Kelly, Harry L. Waddell, Executive Vice President; Tensurer, John J. Cooke, Vice Insulations, and Solicited from engineers and other technical men in the Chemical Process Industries. Publisher reserves the right to refuse non-qualified subscriptions, Position, company connection, and nature of company's business, products, and approximate number of employees, must be indicated on subscription application. Subscription rates per year for individuals application. Subscription rates per year for individuals and the process of the Cooker 56%. Canada S4. other Western Hemisphere \$15, all others \$25. Unconditional guarantee: The publisher, upon written request from any subscriptor, agrees to refund the part of the subscription Price applying to copies not yet maled. See postage paid. Printed in Albany, N. Y., second class postage paid. Printed in Albany, N. Y., second class postage paid. Printed in Albany, N. Y., second class postage paid. Printed in Albany, N. Y., second class postage paid.

Subscriptions: Send correspondence and change of address to Fulfillment Manager, Chemical Engineering, 330 West 42nd Street, New York 36, N.Y. Send notice promptly for change of address, giving old as well as new address. Enclose an address from a recent issue of the magazine if possible. Allow one month for change to become effective.

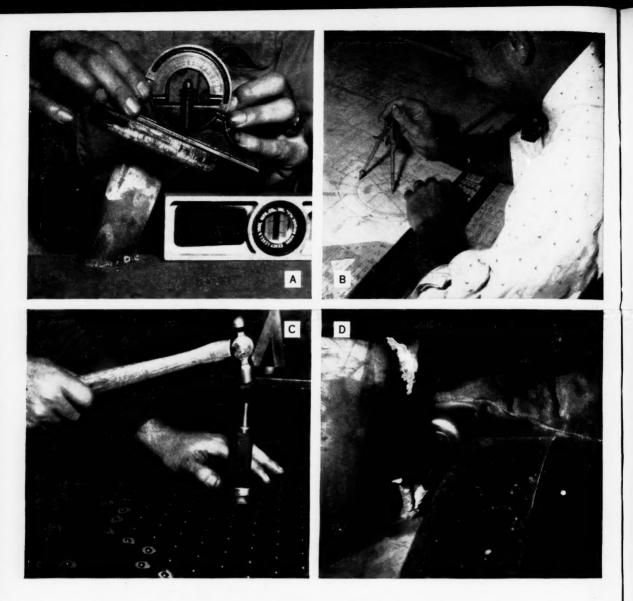
Postmaster: Please send form 3579 to Chemical Engineering, 330 W. 42nd St., New York 36, N. Y.

Circulation





Associated



Where skillful hands work for you

Craftsmanship follows through on every stage of the design and fabrication of pressure vessels and heat exchangers at Downingtown Iron Works. Come and see for yourself. Inspect our shop procedures on work in normal progress. Or write for helpful Bulletins HE and CI.

On the nose—Accurate fit-up...a second check after tack welding...another before shipment...assure nozzles are on the nose, save installation headaches.

"X" marks the spot—and punch mark guides true center of tube hole...holds close ligament tolerances... assures accurate tube sheets and efficient operation.

B Detailing your ideas—in language the shop man understands—means that equipment fabricated here carries out your plans, meets your process requirements.

A Downingtown extra—Back-chipping nozzle weld assures sound weld metal through and through...is one of the DIW extras that go beyond code requirements.

Downingtown Iron Works, Inc.

140 Wallace Ave., Downingtown, Pennsylvania

division of PRESSED STEEL TANK COMPANY Milwaukee

Branch offices in principal cities

HEAT EXCHANGERS—STEEL AND ALLOY PLATE FABRICATION CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS



PUBL
J. Elto

WHA'

Freder

SENIO

PRES EDITO SENIO

ABSIS'
COPY
EDITO

REG

SAN F

San F

Mexico Rio de

in 170

ADV

BUSIN

ADVE

Сни

CHEMICAL ENGINEERING

highlights of this issue

PUBLISHER

J. Elton Tuohig

EDITOR-IN-CHIEF

Cecil H. Chilton

WHAT'S HAPPENING

EDITOR: Calvin S. Cronan

ASSOCIATE EDITORS: Frances Arne, Roland A. Labine

ASSISTANT EDITORS: Charles R. Bamford,

Nicholas P. Chopey, Eugene Guccione,

Frederick C. Price

ENGINEERING PRACTICE

EDITOR: Theodore R. Olive

SENIOR ASSOCIATE EDITOR: Robert B. Norden

ASSOCIATE EDITORS: Steven Danatos, W. C. Schall

ASSISTANT EDITORS: Roy V. Hughson, James R. Marshall, Herbert Popper

PRESENTATION & PRODUCTION

EDITOR: Lester B. Pope

SENIOR ART EDITOR: Frank F. Kozelek, Jr.
ASSOCIATE ART EDITOR: Louis H. Dufault

ASSISTANT ART EDITOR: D. Caratzas

COPY EDITOR: Henry S. Gordon

EDITORIAL ASSISTANTS: Joan Nilsen,

Nancy Pepicello

REGIONAL EDITORS & BUREAUS

HOUSTON: Peter J. Brennan, Wilma Cortines

SAN FRANCISCO: Martin D. Robbins, Terry Shaw

DOMESTIC NEWS BUREAUS: Atlanta, Chicago,

Cleveland. Dallas, Detroit, Los Angeles,

San Francisco, Seattle, Washington

WORLD NEWS BUREAUS: Bonn, London,

Mexico City, Milan, Moscow, Paris,

Rio de Janeiro, Tokyo. Correspondents

in 170 cities in 69 countries.

CIRCULATION

MANAGER: Paul W. Erb

ADVERTISING & BUSINESS

ADVERTISING SALES MANAGER: D. B. Gridley

BUSINESS MANAGER: Anton J. Mangold

PROMOTION MANAGER: Hugh T Sharp

MARKET RESEARCH MANAGER: Jeanette Paschall

ADVERTISING MAKEUP: Grace Barrie

SYNTHETIC GEMS FIND NEW USES IN OPTICS

Any object, animate or inanimate, that combines beauty with utility is indeed a jewel. Linde's new sapphire-encased ruby, used in optical masers, is a good example of why industrial applications now make up the bulk of Linde's market for synthetic gems. How these gems are produced is told in our "cover story" (p. 26).

EXPLOSION SUPPRESSION: NEW SAFETY TOOL

Where absolute prevention of an explosion is difficult to achieve, explosion suppression may be the answer. Monsanto engineer Clayton Hammond tells (p. 81) how a suppression system performed when a dust explosion actually occurred in a hammer mill that was grinding plastics.

ROCKET FUELS BOOST SPECIAL ALLOYS

Optimum combination of both mechanical properties and corrosion resistance to rocket fuels and oxidizers has drawn attention to a class of alloys little known to chemical engineers. These are the precipitation-hardening stainless steels whose Cr-Ni content is indicated by the designations 17-4, 17-7 and 15-7. See Corrosion Forum (p. 108) for useful data on properties and performance.

USE WET FLUID BEDS TO HUMIDIFY GASES

Prof. Norman Epstein of University of British Columbia is apparently the first to propose using fluid beds specifically for the purpose of humidifying gases. In this article (p. 86), he presents experimental data from a 12-in.-dia. fluid-bed humidifier to support his thesis that such devices have certain advantages over conventional spray chambers.

CE Christmas cover is no shot-in-the-dark



That seemingly random arrangement of synthetic gems in our front cover illustration came about through the studied efforts of Senior Art Editor Frank Kozelek (left) and McGraw-Hill's chief photographer, Hans Basken. One major problem: finding the optimum lighting arrangement for bringing out the "Christmas stars" in the star sapphires and rubies. We hope you like the result.

function as predicted. My comment is: Better get a new top executive.

I learned that the young designer no longer works with unit-operations empirical formulae but creates "models" and "programs" so that technicians may play them on a computer. However, the best and most experienced designer still "assumes" the answer and tries out his assumptions one after another till one works.

I would enjoy meeting Mr. Richardson.

DONALD B. KEYES

New York, N. Y.

Sir:

I have about 50 students in my Engineering Orientation course whom I am trying to enlighten as to the mysteries and ramifications involved in the branches and functions of engineering. Mr. Richardson's article, "Coexistence for Design and Operating Engineers?", is a peach as regards these two functions.

R. L. JOHNSON

Portland State College Portland, Ore.

Con: Engineering Conservatism Sir:

Mr. Carroll's article, "Increase Your Plant Profitability" (Nov. 27, pp. 113-8) was a courageous attack on engineering conservatism.

I was rooting for John Bough to receive some tangible recognition for a bold attempt at reducing capital costs. I got the impression he was made more responsible for the design work and received nothing for it.

How about Mike Roe, the production manager, sharing his bonus money with John? After all, John's the guy who helped Mike earn it.

JOHN W. SARAPPO

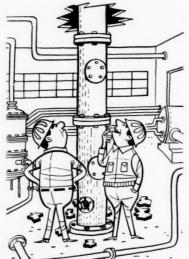
Titusville, Pa.

Pro: Realistic Design

Sir.

I learned a lot from the delightful article by Wingate H. Richardson in your Oct. 16 issue (pp. 216-20).

I learned that the modern chemical plant designer is no longer required to prove that his design will



Pro: Trichloroethane

Sir:

We note your splendid article in the Oct. 30 issue (pp. 62-6) entitled "Competition Sharpens in Chlorinated Solvents." The article appears to be an excellent summation of the current situation regarding chlorinated solvents, except for your discussion of 1,1,1trichloroethane.

Tect, Inc., was the first company successfully to stabilize this solvent, initially offering it in early 1954 under the trade name Vythene. More than 95% of all 1,1,1-trichloroethane on the market today is stabilized this way.

In addition, you greatly underestimate the volume of this material being sold. Indeed, there is a temporary shortage, and 1962 sales will be about 80 million lb.

J. W. PATRICK

Tect, Inc. Northyale, N. J.

Christmas Comes Twenty-Six Times a Year

es at

nd ill ut

er

ES

s-l-s-

Every year at this season, the corner mail boxes are filled with letters in childish handwriting addressed to Santa Claus. Most of these letters are mailed before Christmas; according to the Dead Letter Office, rare indeed is the post-holiday letter to Santa expressing gratitude for gifts received.

Even we adults are often guilty of taking too much for granted. Most of you have noted—and some of you have questioned—the seemingly high single-copy price of this magazine, as indicated on the front cover. What many may not realize is that this price approximates our actual out-of-pocket costs for paper, printing and postage.

If it were not for income from advertising sales, therefore, we would have to charge U.S. subscribers \$20 per year just to recover these production expenses (and overseas subscribers would have their already higher rates increased). At such prices, our circulation would naturally be smaller, and printing costs per copy produced would be even higher. Effective communication of chemical engineering technology would certainly suffer.

Thus we think it appropriate here to acknowledge the part played by advertisers, who make it possible for us to deliver to you a worthwhile publication at a price you as an individual subscriber can afford to pay.

This editorial is not a plea to support our advertisers, nor are we suggesting that you influence your advertising manager to buy space in Chemical Engineering. Your purchasing decisions are rightfully based on firmer economic grounds than loyalty to a magazine, and an advertiser will buy space only when he wants to gain the attention and readership of those who have prime buying influences for his products.

We simply want you to know that in the economics of independent publishing, there are buyers and sellers, but there is no Santa Claus.

-CECIL H. CHILTON

CYANAMID

Chemical Newsfront



the regular dry cleaning cycle, clothing is returned to the machine for the finishing touch — the Venmist spray. In addition to restoring moisture to the clothing, the spray's bactericidal action also prevents perspiration odor from developing on the fabric. The treatment lasts until the next time the clothes are cleaned in the Venclene or Venmist machines. This is the first time that CYANA-GUARD, long used in mill-treated fabrics, has been made part of a dry cleaning process.

(Textile Chemicals Department)

solve

mol



THE VERSATILITY OF PROCESS allows choice of a wide range of basic weights, porosity and thickness to suit your particular needs. Another outstanding feature of this new 100% Acrylic Fiber Sheet is its durability as evidenced by its resistance to rot, common solvents, most chemicals, and ultraviolet light. It is compatible with most coating and impregnating resins and also can be used as a protective or decorative foil in many plastic systems. Its hydrophobic nature, and resultant good dimensional stability, makes this material adaptable to a wide range of new ideas.

(Poper Chemicals Department)



BEAUTIFUL PROJECTION FROM CYANAMID. The rugged housing for this Tower "Seventy-Five" 500-watt slide projector is made of molded BEETLE® urea plastic. Because of Cyanamid's BEETLE, the projector housing has a corrosion-proof surface, good heat-resistance, and does not build up dust-attracting static charges.

(Plastics and Resins Division)

CYANAMID

AMERICAN CYANAMID COMPANY 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.



STABILIZING THE CYANAMIDE RADICAL. For the first time, the cyanamide radical is available as a stable, colorless, concentrated 50% aqueous solution of hydrogen cyanamide. This new form of an old and useful compound contains a minimum of metallic and nitrogenous contaminants.

(Process Chemicals Department)

mail this coupon to:	CE-12
AMERICAN CYANAMID COMPANY	
30 Rockefeller Plaza, New York 20, N.Y.	
Dept. 6365	
Please send me additional information on	
☐ VENMIST CYANA-GUARD	
☐ BEETLE UREA PLASTIC	
ACRYLIC FIBER SHEET	
HYDROGEN CYANAMIDE	
Name	
Company	
Position or title	
Address	
CityZone	State



This big fabrication is no tall story

It took six flat cars to ship this giant out of American Bridge's Orange, Texas, plate shop. Over leared 220' long and more than 12' in diameter, this tower is made from 33 steel rings, formed from ruck an 13/16-inch plates. High capacity boom-mounted electric welders joined the 33 rings, and special fally all x-ray equipment checked the weld seams.

What did we do for an encore? We fabricated office are three more towers, all about the same size—and weighing over 200 tons each.

Badger Manufacturing Company, Engineers and Constructors, designed and erected the towers for a styrene manufacturing plant* now under construction for Sinclair-Koppers Chemical Company.

King-size, custom fabrication is routine at American Bridge's Orange plate shop. Staffed by experienced experts, completely equipped with modern fabricating facilities.





Over leared for all major tank and pressure vessel code work, and strategically located for rail, rom ruck and water shipment; you can rely on precise, prompt and economical service on practicial fally all plate work at American Bridge.

Contact the nearest American Bridge contracting uses its a registered trademark.

Process Licensor: Cosden Petroleum Corporation

ger

om.

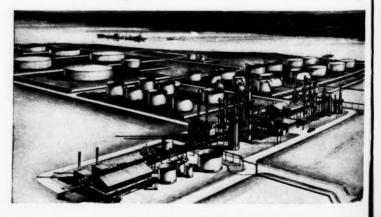
es,

or a metal Offices: 525 William Penn Place, Pittsburgh, Pa. • Contracting Offices in: Ambridge • Atlanta • Baltimore • Birmingham • Boston • Chicago • Cincinnati endand • Dallas • Denver • Detroit • Elmira • Gary • Harrisburg, Pa. • Houston • Los Angeles • Memphis • Minneapolis • New York Offices: 525 William Penn Place, Pittsburgh • Portland, Ore. • Roanoke • St. Louis • San Francisco • Trenton • United States Steel Export Company, New York

American Bridge Division of United States Steel

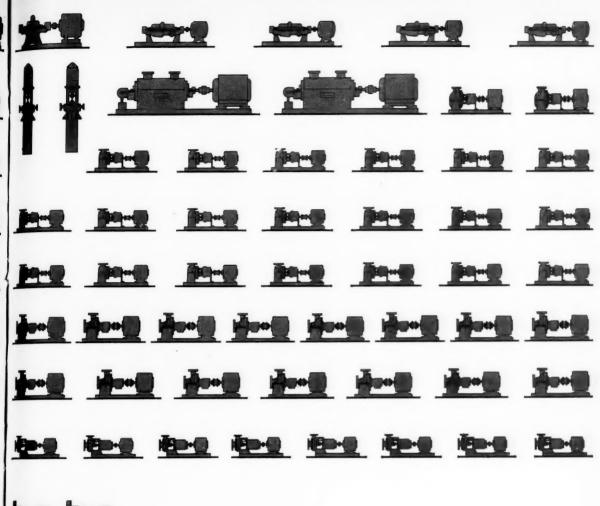


\$4-0 \$4-0 \$40-0 \$40-0 \$40-0 \$1-0 1821-10 1821-10 431-10 These 122 Ingersoll-Rand centrifugal pumps will at new "grass-roots" refinery in F



December 25, 1961—CHEMICAL ENGINEERING

CHEM



20-0 (20-0

will handle a variety of requirements

in Panama

To handle 50,000 barrels of crude per day, and convert it to high octane gasoline takes a lot of pump power. In fact, at Refineria Panama, S.A., the all-new "grass-roots" refinery being designed and built by Bechtel organization for Continental Oil Company and National Bulk Carriers, Inc., it will take 122 centrifugal pumps of 51 different types and sizes—all supplied by Ingersoll-Rand.

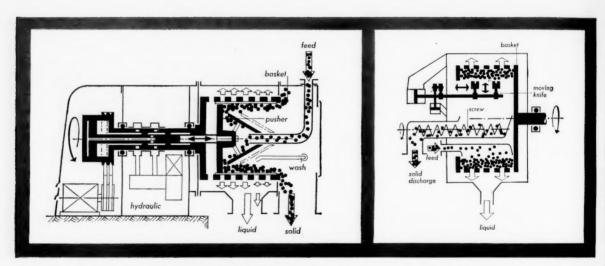
This refinery will also have four I-R reciprocating compressors for process and instrument air service and a 7-stage I-R centrifugal compressor for recycle gas compression.

Call in your Ingersoll-Rand engineer. He has the world's largest pump line and the most comprehensive compressor experience at his disposal.



MORE THAN A CENTURY OF PUMP PROGRESS

2 more choices in solving your liquid-solid separating problems



Short-stroke pusher acting over rotating screen deliquors, washes and discharges crystals continuously with minimum product degradation in Krupp pusher-type centrifuge. Both Krupp pusher and Peeler centrifuges now available from Pfaudler.

Knives in Peeler type take incremental, axial cut to prevent glazing and help residual cake retain its filtering properties.

Krupp-Dolberg of Germany makes these centrifuges. You get them from Pfaudler.

What makes them newsworthy is that neither of these machines has previously been available in North America.

Continuous operation. One is a pusher type. It features a perforated basket and handles solids ranging in size from 0.01mm to 40mm.

It broadens the range of your choice in selecting equipment for *continuous* solids dewatering and washing.

Less cake glazing. Second is the Krupp Peeler type filtering centrifuge designed for automatic-batch operation. Featured are knives that cut radially and axially on the cake, much like a boring tool. With each batch a deeper incremental cut is made, exposing a new filtering surface.

You also get as standard equipment a screw discharge that assures removal of solids.

The Peeler centrifuge is particularly well suited to dewatering and washing filterable inorganic salts and crystals plus slow-draining organic solids.

Feasibility testing. Pfaudler will undertake, at your request, detailed studies

to determine which of these centrifuges can help increase the efficiency of your liquid-solid separations.

The addition of these machines to the Pfaudler line is a logical step in our FLUIDICS program that integrates knowledge, equipment and experience in solving problems involving fluids.

Literature available. If you'd like a more detailed look at these centrifuges, write for *Bulletins 1015* and *1016*. They cover the Krupp pusher and Peeler types, respectively. Please address all inquiries to the address indicated on the page facing.

This in d will phas the This tions Pfau positions

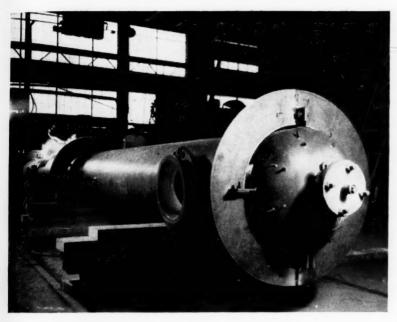
can 2000 fash mula T

into tion to 1 1500 It

regi

In

Сн



What else is new with Nucerite?

This column is. It measures 18 inches in diameter and is 240 inches long. It will be used in a process where vaporphase corrosion has been a problem in the 600°F. range.

This goodly sized column is additional evidence that Nucerite,* the new Pfaudler family of ceramic-metal composites, is increasingly taking the form of production-sized equipment.

Which brings us to more news. You can now get vessels in capacities up to 2000 gallons, for operations to 700°F, fashioned out of one of the many formulations of Nucerite.

The reason Nucerite is fast coming into its own as a material of construction is its unmatched ability to stand up to high-temperature corrosion (500°-1500°F), abrasion, and thermal shock.

It appears to be a practical answer for handling abrasive solids in aqua regia, digesting ores at high temperatures in acid solutions, reconcentrating acids, or handling corrosive vapors at elevated temperatures. Tested in sulphuric acid-recovery concentrators, Nucerite immersion heaters show little build-up of carbon; hence, good heat-transfer efficiency.

On a less spectacular—but still important level—Nucerite is proving itself in manhole extension collars on standard glassed-steel reactors. Both impact and abrasion resistance are the features for this application.

So, news continues to be made about Nucerite. Maybe you're next. Let us send you our data sheet that will put the proper sample in your hands. Ask also for Bulletin 999. It covers Nucerite's impact resistance; stability at high temperatures; tensile strength; resistance to abrasion, thermal shock and corrosion; and heat transfer.

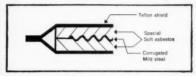
*Patent applied for

Address all inquiries to our Pfaudler Division, Dept. CE-121, Rochester 3, N. Y. In Canada, contact Pfaudler Permutit Canada Ltd., Toronto.

CRT gaskets now standard on Glasteel, reactors

The old adage that a chain is only as strong as its weakest link has its counterpart in process equipment.

That's why we now provide our CRT gasket as standard with Pfaudler Glasteel reactors. With it you can handle corrosives to the maximum temperature limit of the vessel and pressures to 500 psi. This cross-sectional schematic shows you the CRT's construction.



The center core is thin, corrugated mild steel. It gives added strength. Extra-thick soft asbestos provides a spring action that keeps the gasket tight. Thus, little shimming is required. Naturally, the Teflon envelope has a very high corrosion tolerance.

You pay no more. You get the operating efficiencies of the CRT as standard on Pfaudler reactors and also on other equipment such as dryer-blenders and polymerizers. It makes good sense. That's what we strive for in all our equipment. Can we answer any questions for you? Write to the address shown at the bottom of this page.

Do not despair about evaporating "problem" products

Send for this booklet. It tells all about the Pfaudler® Wiped Film Evaporator—how and why it efficiently handles products that are heat sensitive, viscous, or low in thermal conductivity. Also, facts and figures on standard models with 4 to 100 sq. ft. of evaporating area. Test facilities provided for product evaluation. The Bulletin is 991. Free, of course.





PFAUDLER PERMUTITING.

Specialists in FLUIDICS...the science of fluid processes

YOU CALL THE TURN

LINK-BELT WILL MATCH ANY SCREW CONVEYOR NEED



HANGERS have wide top bar with slotted bolt holes for easy assembly and alignment. Available with self-aligning ball bearing or with sleeve bearing in babbitt, hard iron, bronze or oil-impregnated wood.



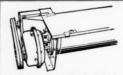
TROUGH ENDS of heavy steel plate are flanged at top and bottom. Furnished with babitted, bronze or single or double ball bearing flange block with or without trough end seal. Blocks are interchangeable.



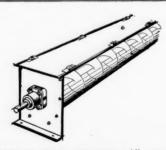
TROUGHS AND COVERS— Troughs are accurately formed and jig-assembled. Drop-bottom type facilitates cleaning. Covers can be semi-flanged, spring clamped type to facilitate removal.



QUIK-LINK CONVEYOR SCREW. For ease in removal of conveyor section without disturbing other components. Can be furnished on helicoid and sectional flight conveyors.



DRIVES—Link-Belt shaftmounted speed reducers are simple, compact, rugged designed for easy mounting on trough end plate. Motogears and gearmotors with roller chain drives can also be furnished.



TYPICAL LINE OF SCREW CONVEYOR—All components required to make up a complete screw conveyor are available from Link-Belt. One call, one order, one shipment for all your needs. And, you have the benefits of one-source responsibility.

SINGLE COMPONENT OR COMPLETE SYSTEM—STANDARD OR SPECIAL REQUIREMENTS! Yes, you call the turn . . . and you can count on Link-Belt to come up with the right

Link-Belt offers conveyor screws in any suitable metal to meet temperature, corrosion, sanitation, abrasion and other requirements. Numerous *standard* types are available from stock in black and stainless steel. And if these can't solve your problem, our engineers will design an economical answer. We have furnished conveyor screws ranging from 1½ inches to over eight feet in diameter . . . with trough clearances as close as ½2". What are your needs?.

Link-Belt offers an equally broad selection of all other components. All are built to rigid quality standards, made to fit together accurately to assure easy assembly . . . smooth, long-life operation.

You'll find Link-Belt screw conveyor components conveniently available from stock in your area. And expert engineering assistance may be obtained through any Link-Belt office. For details, contact your nearest Link-Belt office or authorized stock-carrying distributor. Ask for Book 2989.



SCREW CONVEYORS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Warehouses in All Major Industrial Areas and District Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs; Switzerland, Geneva. Representatives Throughout the World. 15,742

D

COI

che a n pipe Thi win var laye

> In Cor cur is w to-l

lim

tha con pip

at 400 per to e

> Ma affe typ

Pi

Tw cie me

fac

Сн

Chementator

Reinforced-plastic pipe rolls out continuously, using novel mandrel

Cheaper reinforced-plastic pipe may result from a new manufacturing system that produces the pipe continuously in almost any desired length. This is done with a machine that not only can wind glass-fiber tape at any angle, but also can vary the orientation of the fibers from layer to layer to meet different types of stress.

Previous manufacturing operations have limited the length of pipe sections to the length of the mandrel around which the pipe is formed. In the system developed by Carlon Products Corp., Aurora, Ohio, continuous wrapping and curing is done by using a collapsible mandrel that is withdrawn from a finished length into a ready-to-be-formed portion of the pipe.

Although exact prices have not been established for the new product, Carlon estimates that savings of up to one-third may be possible compared with conventional reinforced-plastic pipe.

The continuously produced pipe can be used at 400 psi., has an upper temperature limit of 400 F. Burst pressure is 1,800-3,000 psi., depending on pipe I.D. A special liner can be used to eliminate weeping and increase burst pressure.

Available now in 2½-in. dia., the pipe will soon be made in several sizes from 2 to 4 in. Manufacture by the continuous process does not affect the corrosion resistance properties of this type of pipe.

Processing-for-hire picks up two more converts on the Gulf Coast

Two companies that are striving for self-sufficiency in raw materials have hit upon the same method for minimizing capital investment in new facilities. The device: renting excess processing capacity from another company.

Marbon Chemical, which has a major sty-

rene project under way (Chementator, Nov. 27, p. 45), has arranged for Humble Oil to reactivate an idle butadiene unit at the latter's Baytown, Tex., refinery. Unit will be modified to allow dehydrogenation of ethyl benzene to styrene; Marbon will pay Humble on a fee basis for this service.

Technically, Marbon is receiving a 96% ethyl benzene stream from Humble's Enjay Chemical subsidiary. In practice, however, the ethyl benzene will flow directly to the dehydrogenation unit within the Baytown refinery. Crude styrene monomer will then be piped over the fence to Marbon's new plant for final purification. Thus Marbon will be able to turn out 75 million lb./yr. of styrene with a capital investment estimated at only \$3-5 million.

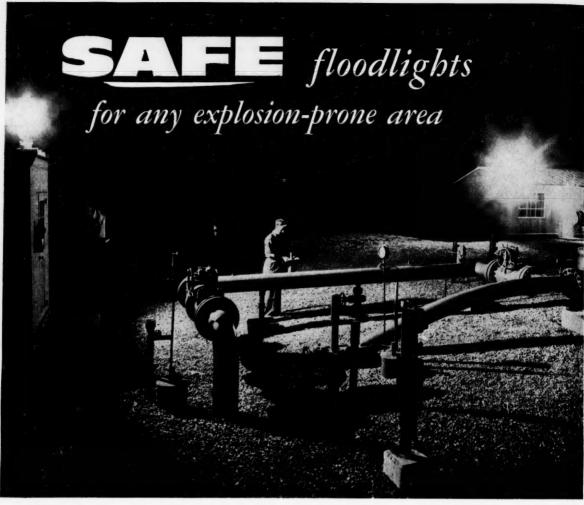
In similar fashion, Monsanto Chemical is arranging to have an unidentified company produce acetic acid from ethylene that will be made at the former's Chocolate Bayou, Tex., plant. Monsanto will use the acetic acid as one of the raw materials for a 45-million-lb./yr. vinyl acetate monomer plant it is building at Texas City, Tex.

Trade sources indicate the other company is Celanese Corp. That firm is building a new acetaldehyde-from-ethylene unit at Bay City, Tex.; part of the acetaldehyde output could then be converted to acetic acid and returned to Monsanto.

Common monomers give unusual polymers via new catalysts

Registrants at the recent AIChE meeting in New York heard a few tantalizing hints about new polymers that may be forthcoming through the magic of stereo-specific catalysis. But like most polymer chemistry, details of these new European developments are cloaked in secrecy.

Norman Gaylord of Gaylord Associates, Newark, N.J., reported that one European company is readying plans to make "polyethylene" from propylene monomer. This seeming con-



These incandescent floodlights are explosion-proof and weatherproof . . . ideal for lighting hazardous areas such as this, tra

tion

pol; cha gro pro

is a

alte

nev

of nat oxy Thi

bot

ket

bui say cho me

Pro

pre

jus sev

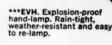
wa

des

*ADDR-12. Dust-ignitionproof floodlight. On aluminum dolly to fit over 33-inch manhole.







What's your illuminating problem?

- Perhaps your problem is dust-ignition-proof floodlighting for dry, dusty, hazardous areas.*
- Possibly you're interested in explosion-proof incandescent floodlights for flush ceiling mounting — something that might be suitable for use in a process control room.**
- Maybe you're looking for rugged, explosion-proof hand lamps for safe lighting of interiors of large fuel tanks during cleaning or painting operations.***

Whenever and wherever explosion-proof illumination is needed — whether in fluorescent, mercury vapor or incandescent lamps — Crouse-Hinds has a unit to fit your application need.

Check Catalog 320 for floodlights and Catalog 3000 for hand lamps. Or, see your Crouse-Hinds Distributor.



MAIN OFFICE: SYRACUSE, N.Y. FIELD OFFICES: Albany, Atlanta, Baton Rouge, Birmingham, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Corpus Christi, Dallas, Denver, Detroit, Houston, Indianapolis, *Kansas City, Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Omaha, Philadelphia, Pitsburgh, Portland, Oregon, St. Louis, St. Paul, Salt Lake City, San Francisco, Seattle, Tampo, Tulsa, Washington. RESIDENT REPRESENTATIVES: Baltimore, Md., Meriden, Conn., Reading, Pa., Richmond, Va., Springfield, Mass. FOREIGN AFFILIATES: Crouse-Hinds Company of Canada, Ltd., Scarborough, Ont., Crouse-Hinds-Domex, S. A. de C. V. Mexico, D. F. MANUFACTURING LICENSEE: Peterco, Sao Paulo, Brazil

tradiction is accomplished by an unidentified catalyst that activates propylene in the 1,3 positions. This leads to formation of a straight-chain polymer, rather than conventional polypropylene chains that have regularly spaced methyl sidegroups. Advantage of this unusual route is that propylene is usually cheaper than ethylene.

A second development described by Gaylord is a new catalyst that activates styrene in the 1,6 positions—leading to polymers that have alternating ethyl and benzene groups in the backbone. Compared with conventional polystyrene that has the benzene ring as a side-group, the new polymer is said to have superior heat-resistance, softening-point and melting-point properties.

Herman Mark of the Polytechnic Institute of Brooklyn reported that new complex coordination-type catalysts can polymerize carbon-to-oxygen bonds as well as carbon-to-carbon bonds. This creates the possibility of polymerizing aldehydes and ketones to form polymers that are both polar and stereo-regular.

Main problem in polymerizing aldehydes and ketones has been the tendency of the polar groups to form stable complexes that prevent polymer buildup. This can be solved with new catalysts, says Mark, by reacting at high temperatures and choosing a solvent that competes with the monomer in formation of complexes.

Use of titanium lining for large reactor vessels, as well as for piping and smaller equipment, will make Celanese Corp.'s new acetaldehyde unit at Bay City, Tex., the biggest customer for Ti in the chemical industry. Wyatt Metal & Boiler Works, Houston, is handling fabrication.

Cost of new sewage plant is sliced in half by zeta-potential control

Promising to become widely used in controlling precipitation, zeta-potential measurement has just been given its first assignment in municipal sewage treatment. Thomas M. Riddick & Associates, New York, which designed the first water-treating plant employing this principle, is now putting it to use in a novel sewage plant design for the city of Norwich, N.Y.

Zeta-potential is a measure of the electrokinetic charge that surrounds suspended particles. If this charge is brought close to zero, coagulation of colloidal material is greatly enhanced. Development of a simple zeta meter for measuring the charge, and special cationic polyelectrolytes for controlling it, have made this a practical way to control sedimentation operations (*Chem. Eng.*, June 26, 1961, pp 121-126).

In the new sewage plant, wastes will be pumped to a flocculating basin, then agitated by rounded wood slats. It is in this flocculation step that zeta-potential is measured and controlled, thereby assuring essentially complete removal of solids during primary treatment. The liquid will then pass to an aeration tank for chlorination and oxygen make-up. The solids from the flocculator will pass to an aerobic digester.

Cost of the 8-million-gal./day plant will be \$550,000. Riddick estimates that it would have been twice as high if the need for secondary treatment had not been eliminated by better flocculation through zeta-potential control. Based on a 16-yr. amortization, this means yearly savings of \$35,000. Cost of the cationic polyelectrolyte will be about \$15,000/yr., for a net saving of \$20,000/yr.

Interest heightens in cleanup process for cracking catalysts

Though still chary with process details and economics, The Atlantic Refining Co. recently disclosed more about its new Met-X process (*Chementator*, Oct. 16, p. 92) for removing metal contaminants from petroleum cracking catalyst.

Met-X is based on ion exchange. Contaminated catalyst bleeds from the fluid catalytic-cracking unit and is slurried in water with a cation-exchange resin. After this contacting step, an undisclosed operation in a vertical column separates contaminant-loaded resin from the slurry. Then, catalyst is dewatered and dried for re-use, while a mineral acid regenerates the resin.

Atlantic has a 40-ton/day Met-X unit at its Philadelphia refinery, is using the facility to decontaminate catalyst from a cat cracker that can handle 30,000 bbl./day of fresh feed. Company expects the cleanup unit to bolster net income of the cracking operation by at least \$1 million/yr.

Planning to license its process, Atlantic (Continued on page 22)





New Honeywell Series 10/20 Millivoltmeters give you an easier-reading scale, and all the latest features for indicating, controlling and safety cut-off.

NEW HONEYWELL MILLIVOLTMETER LINE

gives wider selection . . . greater accuracy

The newly designed Series 10/20 provides accuracy of $\pm \frac{1}{2}\%$, plus all the latest features in millivoltmeters for indicating, controlling and safety cut-off. Wide selection of ranges and control units makes it easy to match the Series 10/20 to your specific process requirements. Extra-sturdy construction ensures accurate and reliable service even under severe operating conditions.

Here's what you get with the New Series 10/20 Millivoltmeters:

higher accuracy

Accuracy $\pm \frac{1}{2}\%$. High resistance measuring circuit minimizes calibration shifts due to changes in external resistance.

simplified installation

Dual-voltage transformers permit operation from either 115 or 230 volts. Dual tap connections make installation easy.

reads easy, reads right

Large, clear six-inch scale with anti-parallax mirror ensures easy, accurate reading.

plug-in maintenance

True plug-in design enables you to replace major components in seconds.

high-brightness signal lights

Amber and red lights show at a glance the exact relationship between temperature and set point.

variety of ranges

A wide selection of ranges is available to measure temperatures as low as 325°F and as high as +3400°F within spans as narrow as 400°F and as wide as 3000°F.

thermocouple burnout protection

Process shuts down in event of thermocouple open circuit.

control forms to fit needs

There are 14 different control forms to give you exactly the control action you need: spst; spdt; sp3t with adjustable neutral; Pyr-O-Vane for electric on-off, two-position or three-position control; Proteet-O-Vane for excess temperature cut-off with signalling or shutdown feature; Pyr-O-Pulse for pulse-proportioning control; and Pyr-O-Volt for current proportioning control.



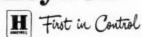
for economy in less demanding applications . . . HONEYWELL SERIES 10/10 MILLIVOLTMETERS

Here's a millivoltmeter line that's ideal for those applications where demands are less stringent, and where accuracy requirements are within $\pm 1\%$. The Series 10/10 provides many of the design and construction features of the 10/20. It's the only economy millivoltmeter line with a full six-inch scale. These units are available in vertical cases only, with $\underline{\text{Pyr-O-Vane}}$, $\underline{\text{Protect-O-Vane}}$, and the new anticipatory $\underline{\text{Pyr-O-Pulse}}$ control units.

Get complete technical data and prices on the New Honeywell Series 10/20 Millivoltmeter Line by contacting your local Honeywell field engineer. Be sure to ask him about the economy Series 10/10. Minneapolis-Honeywell, 21 Penn Street, Fall River, Massachusetts. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

Honeywell

HONEYWELL INTERNATIONAL Sales and Service offices in principal cities of the world,
Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.



points out that Met-X can yield three benefits:

 It eliminates need to purge contaminated catalyst, thus lowering fresh-catalyst demand to the replacement of attrition losses only.

• It allows refiners to crack more-contaminated stocks, thus allowing feed of heavier, higher-boiling streams to cat cracking. Conversely, use of Met-X allows an ordinary feedstock to be cracked into a more valuable slate of products.

• It can increase the capacity of a cat cracker by up to about 25%, because metal-removal will ease cracking's twin bottlenecks of coke formation and light-gases production.

In its own use of Met-X, Atlantic is initially aiming to cut requirements for fresh catalyst. But the firm also has plans to crack heavier stocks, and expects to eventually take advantage of the capacity increase that Met-X offers.

New method for removing alkyl mercaptans from cracked gasolines is on stream at Mobil Oil Co.'s Casper, Wyo., refinery. Gasoline is first mixed with air, then contacted with a caustic-cresylate solution containing 0.05-0.25% cobalt chelate. Cost of chemicals for this process is only half that of the conventional copper chloride route.

Metal boride is basis of long-sought breakthrough in aluminum making

Kaiser Aluminum & Chemical Corp. and British Aluminum Co. have announced joint development of an improved aluminum reduction cell that markedly increases production efficiency. Net effect of this and related research will be to substantially increase aluminum capacity in the U.S. with little increase in investment.

The modified cell is 15% more efficient than the conventional unit. This means that 1 lb. of aluminum can be produced with 15% less electric power, or that output can be increased using the same amount of input power. Both companies are currently operating the new cells on a test basis in commercial reduction facilities.

Only detail about the development given out officially is that the cell "utilizes refractory hard metals as essential elements." But the general outlines of the development are well known in the

industry, and it is believed that all the major aluminum companies are working along similar lines.

Basis of the improvement is the substitution of either titanium or zirconium diboride elements for the usual iron bars that act as the cathode. Unlike the iron, which has to be protected from the corrosive molten aluminum and cryolite by several inches of carbon, the diboride can operate in direct contact with the reduction bath, thus increasing the current efficiency.

Another possibility receiving serious consideration is the use of refractory materials such as nitride-bonded silicon carbide to line the walls of the reduction cell (*Chementator*, Aug. 22, 1960, p. 52). Refractory producers such as The Norton Co., Worcester, Mass., have been actively working with aluminum producers on both aspects of cell improvement, and expect that a major market for borides and carbides will soon be opening up in the aluminum business.

"Who owns your knowledge?" plays big role in process secrecy lawsuit

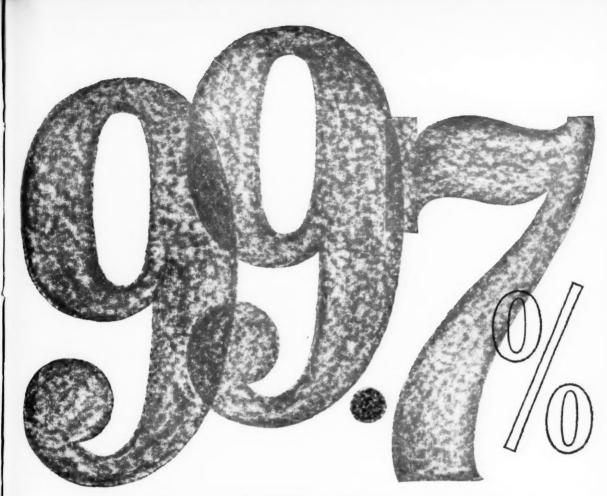
Another battle over who owns an engineer's knowledge is shaping up in southern New York's Federal District Court. Du Pont is charging Von Kohorn International Corp., White Plains, N. Y., with illegally acquiring know-how on Du Pont's nylon and polyester processes.

Du Pont contends that Von Kohorn hired away Du Pont employees with the specific intent of learning process secrets. Du Pont further alleges that Von Kohorn then sold the processes to other companies and obtained patents, in several countries, based on Du Pont techniques.

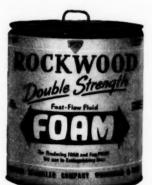
Three technical employees are involved in the suit against Von Kohorn. Two quit Du Pont's Argentine affiliate, Ducilo Argentina, while a third went to Von Kohorn directly from Du Pont. The two workers leaving Ducilo are charged with taking drawings of equipment used in nylon production, while the third is said to have taken an operating manual on polyester production.

Although Du Pont alleges that the former employees took documents away with them, its complaint makes more of the fact that these employees had signed secrecy agreements when they went to work for Du Pont. The company's secrecy agreement is unusual in that it prevents employees from ever using or disclosing proprietary information. Most industrial secrecy agreements are not so broad, usually limiting the non-

CHEM



of Rockwood FOAM protection is FREE! FOR FIRE FIGHTING purposes Rockwood Strength FOAM is inexpensive and completely



jor lar

ion
nts
de.
om
by
er-

ch lls 60, on kof

ng

ed

nt

er

es v-

in

's

ıt.

th

0-

er ts se

en

ts

e-

n-

ROCKWOOD SPRINKLER COMPANY

A Division of The Gamewell Company
A Subsidiary of E. W. Bliss Company
Engineers Water... to Cut Fire Losses

FOR FIRE FIGHTING purposes Rockwood Double Strength FOAM is inexpensive and completely effective. 3 parts Rockwood Foam Liquid, plus 97 parts free water, plus 900 parts free air give you a fast low-cost fire extinguishing agent for only 1½ cents a gallon!

Rockwood Double Strength FOAM puts out fires fast... reduces your storage costs... reduces shipping costs too! If you're using other types of special hazard fire extinguishing agents — you may not be using the most economical or most effective agent! We'll show you how to save on training cost and on fire fighting costs — and to fight fires better! Send in the coupon below. Tested and listed by Underwriters' Laboratories, Inc. Distributors in all principal cities.

ROCKV Portable 526 Ha	le l	Fi	re	3	P	e	e	t		0	t	i	01	n	26	D	t	e	r	I	t:	n	N	1:	na	38	36	10	el	11	18	36	et	t	s					
Please fire-figh	sei	no	1	ľ	ne		•	c	0	n	1	p	le	et	E		i	n	fo	01	r	n	a	t	i	01	n	-	01	n		F	20)(:k	13	N	0	0	d
Name.																																								
Title																																			ě					
Compa	ny																,					0	0	٠	۰				٠									0		10
Street.																																								
																								-																

disclosure period to 2-10 years (Chem. Eng., July 28, 1958, p. 127).

A similar "forever" time clause in the secrecy agreement of Chas. Pfizer & Co. drew the fire of the Dept. of Justice as part of the department's action against Pfizer's dominant position in citric acid (*Chementator*, June 30, 1958, p. 47). No ruling has yet been forthcoming on the legality of this clause, however.

Among the points Von Kohorn makes in flatly denying Du Pont's charges: (1) it has never built a plant using any Du Pont know-how; (2) while Du Pont's continuous polyester process is patented, no patent infringement is claimed in the suit.

Esso Research & Engineering Co. has received a \$50,000 contract from the U. S. Pubic Health Service to investigate foam fractionation as a way to remove synthetic detergents from sewage water. Method involves aerating the wastes, then skimming off the resulting foam.

Next goal for fluid-bed phthalic process: utilization of o-xylene

In a paper given before the New York meeting of AIChE early this month, Badger Mfg. Co. disclosed that it is working on a modification of its fluid-bed phthalic anhydride process that would make the route adaptable to *o*-xylene.

Badger indicates that to obtain this flexibility a second catalyst will be needed. This is in contrast to new types of fixed-bed phthalic catalysts that will give satisfactory yields with either naphthalene or o-xylene (Chementator, Nov. 13, p. 108).

Badger points out, however, that the catalyst in a fluid-bed unit is easily removed from the reactor. Units containing 50-100 tons of catalyst can be unloaded at a rate of 10-20 tons/hr. through a 4-in. transfer line, allowing complete catalyst removal in one shift.

As for economics of the modified route, Badger says that o-xylene would have to sell for 1e/lb. less than naphthalene to make a catalyst shift attractive. Currently, the naphthalene-based process is said to be achieving yields of 95 lb. phthalic per 100 lb. of petronaphthalene, on a

commercial scale. Total production cost, including depreciation, is $8.8 \ensuremath{\rlap/e}/lb$. of phthalic, assuming $6 \ensuremath{\rlap/e}/lb$. for naphthalene. And Badger expects the price of naphthalene to drop to $5 \ensuremath{\rlap/e}/lb$. in the near future, slashing production costs to less than $7.8 \ensuremath{\rlap/e}/lb$.

Besides operation at the original Sherwin-Williams plant, the fluid-bed process is now fully operable at two other plants in the U.S.: Reichhold Chemical's 30-million-lb./yr. unit at Elizabeth, N.J., and Hatco Chemical Co.'s 30-million-lb./yr. unit at Fords, N.J. In addition, Monsanto Chemical is going through shakedown runs at a 50-million-lb./yr. unit near Paulsboro, N. J.; and a 50-million-lb. unit is being built for Union Carbide at Institute, W. Va. that is due on stream in February.

All-plastic tanks drive for bigger stake in transport

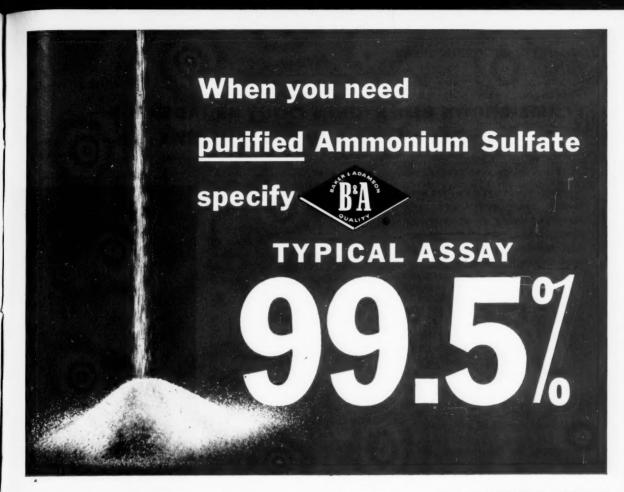
Signalling determination to win a bigger share of the 4,000-unit/yr. tank-trailer market, Haveg Industries displayed a 4,300-gal, all-plastic tank at the New York Chem Show last month.

The company already has about a dozen reinforced-polyester trailers on the road, most of which carry bleach and sodium hydroxide. For more-corrosive service, e.g., carrying chromic or fuming nitric acids, Haveg has patented a method for bonding rigid polyvinyl chloride to the reinforced polyester. The technique involves etching the PVC before bonding.

The company's eventual target is the whole broad spectrum of tank-hauled chemicals, which currently calls for about 1,500 new tanks per year. Within two years, the company expects a \$1.5-million market. Advantages: plastic tanks average 25% lighter than those made of competing materials, permitting a corresponding increase in payload. Polyester tanks, according to Haveg, are competitive in cost with steel; PVC-polyester will run about \$2/sq. ft. more than straight reinforced polyester.

Some other companies that have experimented with all-plastic tank trucks are not as optimistic as Haveg, however. They point out that unlined reinforced polyester cannot always be thoroughly cleaned after use. Often the contained chemicals impregnate the plastic slightly, limiting markets to those where this condition is no deterrent.

For More Industry & Economic News...p. 26



Ordinary commercial ammonium sulfate is a by-product. Not B&A purified grade. It is produced as a primary product, from carefully selected raw materials, to rigidly applied specifications.

You can tell the difference. Just compare the typical analysis given at right, with an analysis of the ammonium sulfate you're currently using. You'll see that the exceptionally low levels of iron, lead and arsenic in B&A ammonium sulfate provide the superior quality you need for high purity end products.

That's why B&A purified ammonium sulfate is preferred for manufacturing and processing foods and pharmaceuticals.

When you want to make the best, start with the best. In ammonium sulfate, as in so many other fine chemicals, that means B&A.

B&A® AMMONIUM SULFATE, PURIFIED

Typical analysis

Assay99.5%
Insoluble 0.007%
Residue after ignition 0.01 $\%$
Chloride (Cl) 0.0005%
Phosphate (PO ₄) 0.001%
Arsenic (As) 0.00002%
Heavy Metals (as Pb) 0.0002%
Iron (Fe) 0.001%

BAKER & ADAMSON® Fine Chemicals

cludning the near

than

win-

eichlizalionanto

at a and nion eam

veg ank zen t of

For

or

eining

ole

ich

per s a

nks et-

in-

to C-

an

as out

ys only,

on

26

NG



GENERAL CHEMICAL DIVISION

40 Rector Street, New York 6, N. Y.

Please send export inquiries to: Allied Chemical International, 40 Rector Street, New York 6, N. Y.

FLAME-GROWN GEM STONES ENJOY BROADENED USE IN OPTICS AND FASHION JEWELRY

Sapphire-encased rubies and black star sapphires are boosting sales of man-made gem stones, one of the chemical industry's most unusual and valuable products.

The \$5,800* Christmas tree adorning the cover of this issue represents the output of one of the country's most unusual "chemical" plants: the multimillion-dollar crystal products facility of Union Carbide Corp.'s Linde Co. at East Chicago, Ind. This is the only plant in the U.S. equipped to turn out crystals of corundum (sapphire), spinel and titania in gem quality.

Two of the newest crystals to be announced by the company are a sapphire-encased ruby rod (for optical masers) and a "honey-black" gem (for jewelry). Industrial sales for electronics, semiconductors, optics, wear and polishing applications now make up the bulk of Linde's multimillion-dollar annual sales. But sales of gem stones for jewelry have been growing more rapidly—about 40% per year in the past three years—due mainly to the success of the star sapphires.

► Masers: Unlimited Potential — Linde's single most promising new stone is probably the sapphire-encased ruby (Chem. Eng., Oct. 31, 1960, p. 46). Used in optical masers, this crystal now accounts for 15% of the firm's industrial gem sales, even though this combination didn't exist 18 months ago.

The optical maser is essentially a light amplifier and is being researched intensively by organizations such as Bell Telephone Laboratories and Hughes Aircraft Co., for use in communications, physical

research and military defense. Because the ruby crystal emits a beam of extremely high frequency (around $4.2 \times 10^{\circ}$ cycles), it should be possible to impress vast amounts of information on a single beam—once researchers learn both how to operate a solid-state maser continuously and how to modulate the signal.

In telephone communications, it should eventually be possible to send messages on maser beams through underground conduits (to keep the light beam free from atmospheric interference). A single such beam would have the capacity to carry all of the present cross-country telephone traffic.

►Light From Electrons—The maser overlay crystals have a ruby core, up to 0.08 in. dia, and 1.5 in. long, containing 0.05% chromic oxide. Sapphire overlay brings final dimension up to 0.20 in. o.d.

When operating as a maser, the crystal is surrounded by a helical-shaped xenon-arc "light pump." Light from the arc excites chromium atoms in the ruby to emit light of a specific frequency. Geometry of the crystal causes the light waves to be reinforced, so that a concentrated beam of parallel rays exits from one end.

The high refractive index of the sapphire (1.76) focuses light toward the ruby core and reduces heat absorption, increasing the intensity of the emission. Since equivalent temperature is 10¹⁰ K., it is possible to concentrate enough energy in these beams to punch holes in thin metal plate.

► How They Are Grown—The maser crystals, as well as the rest of Linde's crystal output, are grown by highly refined versions of the 60-year-old Verneuil flame-fusion process (see diagram).

To produce the two-part maser crystal, ruby is first grown in the shape of an optical-quality disk, 5

Alu

SCF

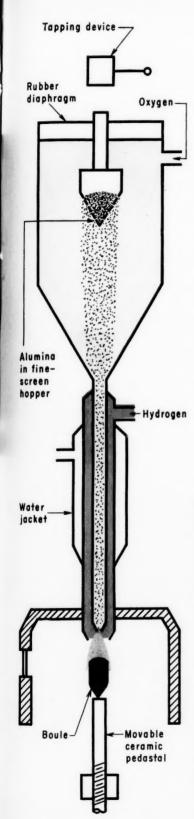
CHE

Intense 3,900-F. heat of an oxyhydrogen flame—converts powder to synthetic gems (photo above). Essential features of this process are shown in the diagram at the right. Pure alumina powder, containing proper coloring compounds, falls into the flame at a carefully controlled rate. Alumina melts, then deposits on a seed crystal supported on a pedestal that is lowered at a rate of about 1 in./hr. The crystal normally forms into a cone-shaped boule, 2-3 in. long and 1-in, maximum dia.

in. in dia. Rods are machined from the disk and chemically polished to almost perfect cylinders. The polished rod is inserted in the chuck of a second furnace and rotated horizontally as the sapphire casing is applied. Finally, the combination crystal is annealed for several hours to reduce internal stresses.

► Refining the Refinements — Optical-grade ruby must be of even

^{*}Approximate retail value of the stones. Among those shown: synthetic star rubies; blue, black and white star sapphires; clear blue and white sapphires; and clear ruby, topaz, spinel, titania and aquamarine. See p. 6 for more details.



nial in

re

er he a al al

l-k

g

n

2

n

G

higher quality than ruby for gem stones. Besides maximum purity, the crystal must have total continuity, i.e., lack of polycrystallinity and "twinning," plus uniform dispersion of the chromium throughout. To obtain this high degree of crystal perfection, variables such as raw-material purity, flame temperature and crystal platform speed must be tightly controlled.

To prepare alumina powder raw material with less than 200-ppm. impurities, Linde first produces alum from ammonium and aluminum sulfate, then purifies via a three-step recrystallization. Pure alum is finally calcined to alumina.

Oxygen used in the furnace is 99.95% pure. And Linde refines its own hydrogen to 99.95% purity by using molecular sieves to adsorb hydrocarbons from a byproduct H₂ stream it purchases from a nearby Union Carbide Chemicals plant.

► Control in the Furnace—Close control of the oxy-hydrogen flame temperature is especially important for uniform chromium dispersion, since changes in temperature will alter the rate of chromium vaporization. The flame is controlled within 25 F. at about 3,500 F. by

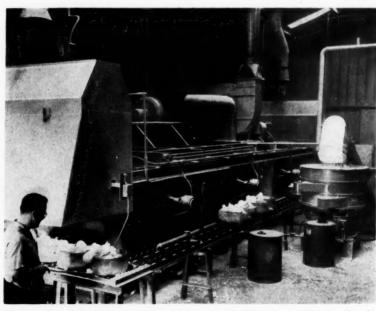
using sensitive optical pyrometers that regulate the flow rate and ratio of the oxygen and hydrogen feeding the burner.

Variables related to flame control and crystal withdrawal are all controlled automatically, so that for most crystal-growing the operators merely have to charge powder feedstock, turn on the furnace, then remove the finished crystal, or "boule."

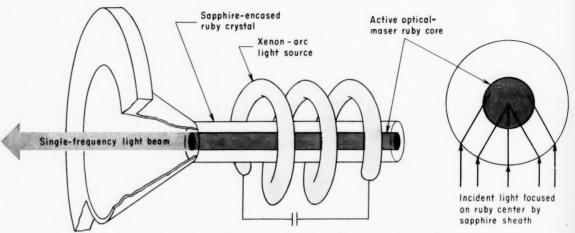
Linde has also had to develop improved lapidary methods (cutting and polishing) to meet the close tolerances on parallelism and end-flatness for optical crystals.

► Selling to the Jeweler—The making and selling of synthetic gems created many problems that are unique within Linde Co. and the Union Carbide organization.

First, the products are small-volume, high-priced items, unlike industrial chemicals. And there is much hand labor involved, especially in the cutting and polishing steps. Clear ruby boule can be produced for several cents per carat, for example; but a cut gem stone or an optical-grade ruby costs several dollars per carat because of the hand work needed. (Star boules cost



High-purity alumina is made by calcining alum in furnace at rear, then breaking up resulting "snowballs" (on conveyor) on vibrating screen at the right.



Ruby core of optical maser emits intense beam of parallel light rays.

Genealogy of Synthetic Gems

CORUNDUM: crystalline alumina (Al₂O₅). In its pure form, corundum appears as clear water-white sapphire. Ruby is merely corundum with several percent chromium oxide added; comparable quantities of titanium and iron oxides give blue sapphire. Salts of cobalt produce green; golden or topaz color comes from nickel and magnesium. Doping compound for the new black stars is still a secret.

Star sapphires and rubies form when less than 1% titania is added to the crystal as it is growing. A subsequent heat-treatment at 2,200 F. causes the titania to precipitate as fine needles along the crystal planes. After proper grinding, the accented crystal planes show up as a white sixpointed star when the stone is viewed under a point-source light.

SPINEL: crystalline magnesia-alumina (MgO•Al₂O₈). Pure spinel is transparent and water-white. It can take on many colors, such as deep blue from cobalt oxide, and aquamarine from a complex mixture of nickel, cobalt, vanadium and titanium oxides.

TITANIA: tetragonal rutile form of titanium dioxide (TiO₂). This pale yellow stone, seldom found in gem quality in nature, surpasses diamond in brilliance because its high refractive indices (2.61 and 2.90) are higher than diamond's 2.41. Titania's Moh hardness, however, is only 7-7.5 compared with diamond's 10.

EMERALD: beryllium aluminum silicate (BeO·Al₂O₃·6SiO₂). All synthetic emerald processes are tightly guarded trade secrets. It's known, however, that emeralds can be grown from solution on a beryl seed crystal at elevated temperature and pressure.

about ten times as much as the clear stones.)

Finally, while selling of industrial stones can be accomplished on the basis of price and performance, marketing to the jewelry trade is much more complex because of the intangibles involved. There has been a built-in bias against anything "synthetic," even though most of the synthetic gems are more perfect from a crystal standpoint than are natural stones. (The primary way that experts tell synthetics from naturals: flaws are more pronounced and irregular).

As a part of its gem marketing program, therefore, Linde advertises directly to the consumer to combat the misconception that anything synthetic is necessarily inferior, an idea that has its roots in unfortunate consumer experience with synthetic materials during World War II. Linde doesn't sell its gems directly to the public, however. It works through three major gem distributors who sell in turn to jewelry manufacturers who mount stones in settings, then sell them to retail outlets for sale to public .- RAL

Broader Support Urged for Plastics Standards

A consideration of future profits alone should convince the U.S. plastics industry to participate more actively in setting of international standards for plastics. This is the opinion of Dow's W.E. Brown, voiced at the recent meeting of the American Standards Assn. in Houston.

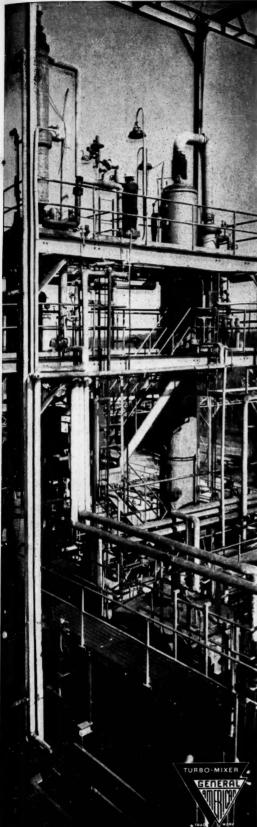
Attacking a growing industry tendency to dismiss the value of international standards, Brown noted that although the U.S. had organized the Technical Committee on Plastics within the International Organization for Standards (see Chem. Eng., Nov. 13, p. 210), there

is growing sentiment for cutting back participation, because some companies can't see any immediate payout.

Charging that this is a shortsighted attitude, Brown cited several benefits to be derived from international standardization: (1) it helps shape uniform national standards; (2) it enables sellers to discuss specifications with buyers on a uniform basis; (3) it promotes product uniformity and thus boosts plastics usage; (4) it simplifies international exchange of technical information.

Brown pointed out that the U.S. stands to gain by leading in international standardization, and if this country loses the initiative, others are sure to fill the vacuum.

CHEM



ting lver-

r to

anyin-

s in ence ring

sell

owajor

who

sell to

ing

ome

iate

ort-

sev-

in-

it nd-

disn a

sts

in-

ical

I.S.

er-

his

ers

ING

TRY THIS SIMPLE QUIZ ABOUT THE **RDC** COLUMN

1. R.D.C. stands for

- ☐ a) Rapid Dispersion Column
- □ b) Recycle Displacement Column
- □ c) Rotating Disc Contactor

2. RDC Columns are made by

- □ a) 6 different manufacturers
- □ b) by one manufacturer
- □ c) by 10 manufacturers

3. The RDC column has been used for

- ☐ a) Separation of Hafnium from Zirconium
- □ b) Caustic extraction of acids from organics
- c) Caffein and vanillin extraction

4. The RDC column can be used for

- □ a) liquid-liquid extraction
- □ b) liquid-solid extraction
- □ c) liquid-slurry extraction

5. The RDC column has which of these advantages

- ☐ a) High volumetric efficiency
- b) No interstage coalescing or external settling
- □ c) Low power requirements

Answers

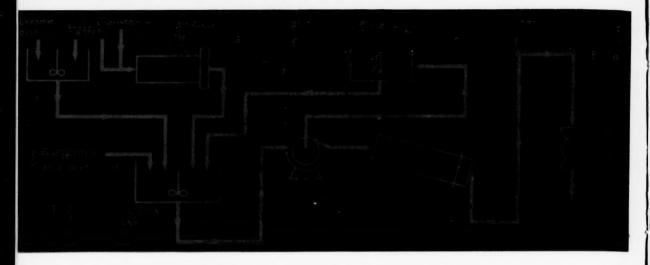
- 1. (C) Rotating Disc Contactor.
- 2. (B) RDC columns are made for the process industries exclusively by General American, and on a non-exclusive basis for the petroleum industry.
- 3. (A), (B) and (C). For a complete list of typical systems in service, contact General American.
- 4. (A), (B) and (C) again. The RDC column is one of the most versatile tools available for extraction processing.
- 5. (We did it again-all three are correct).

It you'd like more information on the RDC column and the many advantages it offers, send for Bulletin T-1159. You'll find it pays to plan with General American.

Process Equipment Division-Turbo-Mixers

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South LaSalle Street • Chicago 3, Illinois Offices in principal cities



PIGMENT PROVES ITS RUST-FIGHTING PROPERTIES

Basic lead silicochromate pigment is backing its initial claims of exceptional anticorrosion properties with results of service life tests over a three-year interval.

Having gained user acceptance for its special anticorrosion pigment, basic lead silicochromate, National Lead Co. is now taking steps to meet anticipated demand for the product.

Introduced commercially three years ago following extensive exposure tests at the company's Sayville, N. Y., and Perth Amboy, N. J., plants, the new product is outperforming older anticorrosive pigments in practical performance tests on the New York Triborough Authority's Throgs Neck Bridge.

Another two years will be required to complete the Authority's tests. However, its engineers are already convinced that the new pigment is superior to ones used previously. So National Lead executives foresee its adoption as the standard anticorrosive pigment for structural steel throughout the construction industry.

With this in mind, the company

is installing a 170-ton storage silo for silica-flour feed material at its St. Louis plant as one step toward expanded output. This will permit receipt of the silica, an important ingredient of the pigment, in bulk freight cars instead of the presently used multiwall bags. Unloading and handling will be by air conveyors. ► How It Came About—Although red oxide of lead has been the accepted corrosion inhibitive ingredient of paints used on structural steel for many years, it has several major shortcomings. Most important: poor color stability, high specific gravity, high costs.

In an attempt to overcome the first limitation, National Lead researchers prepared a basic lead chromate by reacting 95 parts of 75% red lead with 5 parts of chromic acid. Ensuing product was found to be stable in color and to have corrosion inhibition equal to red lead when used in paint applied to structural steel. However, specific gravity of the new product was still high, and bulking value was low. Therefore, the pigment is subject to the same objection as red lead-high cost-which necessitates its dilution with lightweight. bulky materials, to the detriment of its effectiveness.

To overcome the high specific gravity, company researchers turned to a previous development, related to white lead for house paints—production of basic lead-silicate white lead. This product has a much lower specific gravity than conventional white-lead pigments, and thus requires only 60% as much pigment to give the same bulking value as the basic carbonates and sulfates of white lead.

Employing the same general technique as for the production of basic lead-silicate white lead, a coating of monobasic lead chromate was built onto the surface and chemically bonded to silica particles. The resulting product had corrosion inhibition equal to red lead, reduced specific gravity, and increased bulking value. Cost was reduced, since only 50% by weight was required to equal red lead in volume. Tinting value was also reduced, permitting the use of light-color finish coats.

▶ Pigment Preparation—The basic silicochromate is prepared by adding chromic acid solution to slurries of lead monoxide and finely ground silica, along with a small amount of basic lead acetate. The following reaction occurs:

2PbO + CrO_s → PbO•PbCrO_s





In a wide selection of seamless and welded and drawn up to 1" O. D.

- Stainless Steel . . . Nickel . . . Nickel Alloys ... Super and Exotic Alloys
- Glass-to-Metal Sealing Alloys
- Clad Metals and
- Composite Wires . . . Base and Precious Metals

Write for Bulletin No. 13



et



Tubular Products Division J.BISHOP& CO. platinum works

A JOHNSON MATTHEY ASSOCIATE OFFICES: NEW YORK • PITTSBURGH • CHICAGO • ATLANTA • HOUSTON • LOS ANGELES The slurry is dewatered and transferred to a rotary kiln where the lead monoxide reacts with the basic lead chromate to form tetrabasic lead chromate:

 $3PbO + PbO \cdot PbCrO_4 \rightarrow 4PbO \cdot PbCrO_4$

As the temperature is increased in the kiln, the tetrabasic lead chromate reacts with the silica to form monobasic lead chromate and tribasic lead silicate, which combine physically, producing the lead chromate - lead silicate pigment on a silica core.

In the St. Louis plant, silica flour is ground for 20 hr. in an 8×10 -ft. pebble mill to ensure uniformity of particle size (no more than 0.001% retained on a 325-mesh screen). Discharge from the mill is combined with litharge (PbO) and chromic acid in 10×7 -ft. wooden reaction tanks that hold 3,000 gal. Critical point in the operation is control of litharge-chromic acid reaction.

Slurry from the reaction tanks goes to a vacuum filter for dewatering. Filter cake is screw-fed to a continuous rotary kiln operating between 1,100 and 1,200 F. Temperature of the kiln is carefully controlled by photoelectric units connected with two thermocouples. Readings are taken with each revolution of the kiln, as the couples dip into the bed of pigment.

The calcined pigment is fed to a hammer mill, then bagged.

▶ Other Family Members—Since introduction of the basic lead silico-chromate, National Lead has developed two additional silico pigments, each designed for a specific use:

Antimony silico oxide, called Oncor 23A, for flame retardance in halogenated resin compounds.

Lead silico titanate, called Oncor T 15, for improved tint retention through increased resistance and durability in tinted house exterior paints.—AVG

Simple Method Detects Water Contamination

To partially allay growing concern over water contamination, a simple test for determining presence of synthetic detergents has been devised by G. J. Crits, assistant technical manager of the Cochrane Div. of Crane Co. Although the test is specific only for detergents, presence of these materials in ground water may indicate that the water is also being polluted by bacteria and viruses from nearby sewers or cesspools.

Test is performed as follows: a tall cylindrical bottle, similar to an olive jar, is half-filled with water sample and stoppered. When the bottle is shaken, presence of high amounts of detergent will cause noticeable foaming.

Sta

Mo

ran

wit

you

pu

ing

thr

pel

De

pu

ha

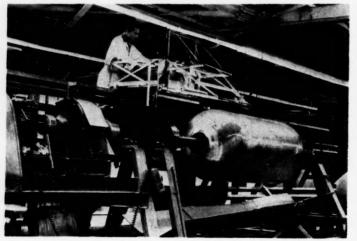
pu

pe

me

Small amounts of detergents, although not foaming, will cause a thin film to travel up the side of the bottle. A ring measuring 0.375 to 1.5 in. high indicates presence of 0.3 to 3.0 ppm. detergents. Presence of acid will increase the ring height, however; so, for accurate results, the acidity of each sample should be adjusted.

Filament winding to add more punch to Minuteman



Lamtex Industries, Inc., Farmingdale, L. I., has been awarded a contract in excess of \$320,000 from Thiokol Chemical Corp., for development and manufacture of glass-fiber-reinforced epoxy casings for first-stage engines for the Minuteman ballistic missile. Casings will be 24 ft. long and 5.5 ft. dia., largest single-piece units ever produced by this method for rocket engines. Firm's Hystran winding process, shown above, controls tension and resin impregnation of each glass filament, rather than winding fibers in bundles as do most processes. Second-stage engines on the Minuteman already use plastic cases. The reason: filament-wound casings weigh only 37% as much as comparable steel units.

Directory Tells Where To Go for Information

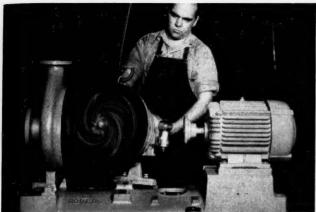
Engineers and scientists burdened with the problem of keeping up with the technical literature have been handed a new tool by the National Science Foundation: a directory of science information services.

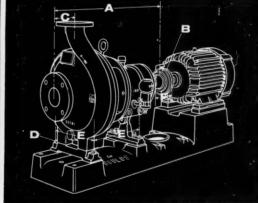
The publication lists 427 information centers that serve the needs of both scientists and engineers in the physical and biological sciences and technology. For each center listed, the directory gives a brief description of scientific specialization and type of service provided.

The 530-page book, entitled Specialized Science Information Services in the United States, is available for \$1.75 from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

PUMPAGE

Goulds news about pumps for process industries





Standardized design features

Model 3195 gives you the greatest range of coverage and flexibility—with minimum parts needed—of any design on the market.

To meet varying service conditions, you can mount any one of the 11 pump ends to any one of three bearing frames (shafts 1½, 1¾, and 2½ through stuffing box). Nominal impeller diameters of 6", 8", and 11" cover the range. Capacities to 775 G.P.M., heads to 300 ft. TDH. Handles liquids up to 500°F.

Dimensional interchangeability between all Model 3195 pumps

With this top-centerline, broad-coverage design, you can interchange pumps without making expensive piping changes. It has

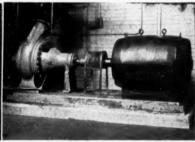
A	One	ove	er-all	le	er	12	(t	h	l				
	in	all	sizes							٠	۰	٠	23"

- B One coupling fit for all sizes...... 11/8"
- C One dimension end from suction to centerline of discharge 4"
- D One bolt size for holding pumps to bases.....
- E One bolt spacing for holding all pumps to bases
- F One spacer coupling length for all sizes.... $3\frac{1}{2}$

1/2"

Back pull-out design lets you easily replace parts most subject to wear without disturbing pipe connections or motor mountings. For full information, write for Bulletin 725.1.





How to dewater a flood

Deep in a Virginia mine, water that could fast become a flood is being pumped out at as much as 8000 gpm for New Jersey Zinc Company.

More than a generation of miners has grown up since the first of the pumps started working. Yet these pumps, as well as the newer ones, perform so dependably that four more are slated to join them.

more are slated to join them.
All 30 are Goulds single-stage,
double-suction centrifugals. All use
mechanical seals. All are grease lu-

Easy way to diagnose pump failure

Keep complete maintenance records on easy-to-use cards. Failures show chronologically, making it easier to get at the root of the trouble.

Cards are a help in ordering new parts, scheduling lubrication, and in determining pump suitability for new requirements due to process change.

Like a free supply of these pump maintenance record cards? Drop us a line. For information on this, or other products on this page, write Goulds Pumps, Inc., Dept. CE-121, Seneca Falls, N.Y.

Unique-alloy pump fights abrasives

The first pump in the system at Bestwall Gypsum Company's Pryor Mill works on a particularly tough service. It must handle bits of metal and glass the junk remover doesn't get.

It's a Goulds Model 3139 constructed of ISO-40.* This stainless steel alloy, highly resistant to corrosion and abrasion, has BHN hardness of 320 and tensile strength of 140,000 psi.

Do you have a similar severe application problem? Let us know. ISO-40 is available in several of our designs. *Registered trademark of Empire Steel Castings, Inc.

GOULDS



PUMPS



LINDE JOINS SELECT GROUP OF AWARD WINNERS

For an outstanding achievement by its chemical engineers who developed synthetic zeolite adsorbents, Linde Co., Div. of Union Carbide Corp., gets the 16th biennial Kirkpatrick Award at Hotel Astor banquet, November 28. Also honored, with Certificates of Merit, were the other finalist companies.



Congratulations to Linde President W. B. Nicholson (right) accompany unveiling of Kirkpatrick Award plaque by *Chemical Engineering* Publisher J. E. Tuohig.



Inventor of Linde's synthetic zeolite adsorbents, R. M. Milton (center) shares his elation over Award with R. W. Pressing, general manager, new products (left) and E. R. Behnke, manager, molecular sieves.



The you perf taki imp

Award Committee Chairman M. S. Peters tells how the Committee selected a 1961 winner, after narrowing the field to five finalists. (Turn page.)

"Made OF Stainless Steel ...Made BY Jenkins"

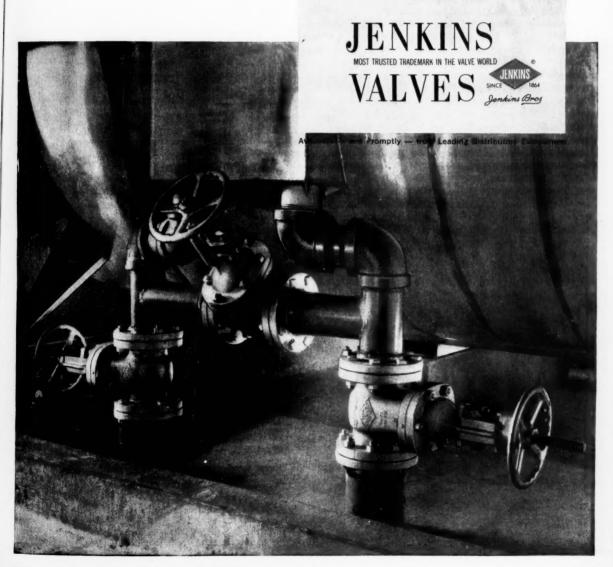
Valve Performance Shows the Big Difference in that Spec!

When service conditions require valves of Stainless Steel, remember that metal is only part of the answer to long, dependable valve performance.

The WAY valves are made is equally important. Factors you can't even see make a big difference. Such factors as perfection of castings... precision machining... painstaking inspection and testing... sound design. Most important of all: the maker's guiding policy about quality. To be sure about all these critical factors, experienced

specifiers and buyers specify JENKINS as well as the metal alloy when Stainless Steel valves are needed. It is well-known that for almost a century Jenkins has made valves to *just one* standard of quality... the highest. At Jenkins every operation, every worker is aimed at fulfilling that standard, whatever metal a valve is made of.

SEND FOR NEW CATALOG 59-SS of Jenkins Stainless Steel valves in types and alloys to satisfy most needs. Jenkins Bros., 100 Park Ave., New York 17.





Featured speaker Admiral Arleigh A. Burke, USN (ret.), former Chief of Naval Operations and Chairman, Joint Chiefs of Staff (left), gets his briefing on the Award's history from Toastmaster S. D. Kirkpatrick.



Secretary C. H. Chilton of the Awards Committee reads citations that highlight achievements of all winners.

Fur

agir

and

Wh

pot half the tim 3 ti

Other finalists get Certificates of Merit for chemical engineering achievements



Catalytic hydrodealkylation route to naphthalene, benzene: Ashland Oil and Refining Co., E. F. Wells, president.



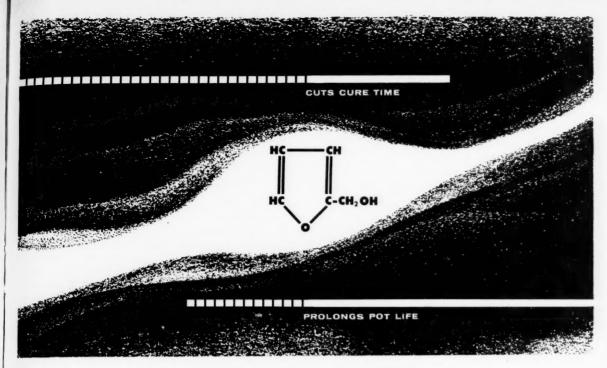
Synthetic straight-chain primary alcohols from ethylene: Continental Oil Co., E. R. Baker, general manager, R&D.



On-line computer control of synthetic ammonia facility: Monsanto Chemical Co., W. M. Cooper, director of applied mathematics dept., research and engineering div.



Pioneer application of computer control to refinery unit: Texaco, Inc., T. A. Mangelsdorf, senior vice president; TRW Computers Co., D. L. McGurk, manager (left).



QO° Furfuryl Alcohol Modifier of Urea Formaldehyde Resins

Furfuryl alcohol (FA®) has a marked effect on urea formaldehyde resins—improving gap-filling properties, craze resistance, stability to heat and aging.

Furthermore, the addition of furfuryl alcohol can improve the relationship between pot life and curing speed of urea formaldehyde resins. When catalyzed and buffered to give equivalent pot life, the FA modified resin cures in about half the time required for the unmodified; when the resins are adjusted to have the same cure time, the FA modified resin has a pot life nearly 3 times as long. A marked improvement! AND,

furfuryl alcohol remains as part of the cured resin solids.

Glue manufacturers use furfuryl alcohol to make gap-filling adhesives based on urea form-aldehyde resins. And, too, they get glues that are flexible, resist crazing and deterioration upon aging. Other plus values include reduced shrinkage and the assurance of enduring bond under varying conditions of pressure, temperature and glue line thickness.

We suggest you see what furfuryl alcohol can do for you. Write for Bulletin 205.



igh-

The Quaker Oats Company

CHEMICALS DIVISION

335C The Merchandise Mart, Chicago 54, Illinois

Room535C, 120 Wall St., New York 5, N. Y.

Room 435C, 49 S.E. Clay Street Portland 14, Oregon In the United Kingdom:

Imperial Chemical Industries, Ltd., London, England

In Europe:

Quaker Oats (France) S. A., 3, Rue Pillet-Will, Paris IX, France; Imperial Chemical Industries (Holland) N.V., Rotterdam, Holland Imperial Chemical Industries (Export) Ltd., Frankfurt a.M., Germany

In Australia:

Swift & Company, Ltd., Sydney

In Japan:

F. Kanematsu & Company, Ltd., Tokyo

NEW EQUIPMENT AND MATERIALS VIE FOR CHEM SHOW ATTENTION

Over 500 exhibitors brought out their newest and best wares to draw the interest of visitors at the chemical industry's biggest spectacle.

Early this month, around 35,000 processing experts subjected themselves to the biennial rigors of the New York Chem Show, officially called the "Exposition of the Chemical Industries." Registrants uncomplainingly endured aching feet, jam-packed aisles and afterhour rituals in hospitality suites, in order to glimpse the latest in equipment, materials of construction and processing aids.

If you weren't able to tour the New York Coliseum in person, here are some of the developments:

Continuous blending in two new types of units was demonstrated by Patterson-Kelley Co., East Stroudsberg, Pa. The first, a solids-solids blender, consists of a series of V-shaped tubes connected in series. Feed is introduced at one end and passes gradually through the rotating unit, with some feed being constantly recycled as it moves from one leg of a V to the next.

Second mixer is a solids-liquid blending device embodying a rotating disk that throws solids outward to the sides of a conically shaped vessel. A whirling annular device spins out liquid in a wide band of foglike particles that contact the falling solids.

A prestressed, impervious-graphite-lined pressure vessel was introduced by Falls Industries, Inc., Solon, Ohio. Vessel is suitable for operation from 0 to 300 F., at full vacuum to 100 psi.; it is highly corrosion resistant and can be heated or cooled via a jacket that is rated at 50 psi. Nozzles can be added or relocated in the field.

Fansteel Metallurgical Corp., Chicago, and R. S. Corcoran Co., Joliet, Ill., have collaborated on an all-tantalum pump for corrosive liquids. With all wetted parts made of Ta, the unit can handle virtually any fluid except some sulfur and fluoride compounds. With the new pump, an entire flow circuit—including tubing, valves and heat exchangers—can now be made from tantalum.

High-temperature plastic pipe, made from Kynar vinylidene fluoride resin, was announced by Tube Turns Plastics, Inc., Louisville, Ky. Useful temperature range of the pipe is said to be -80 to 300 F., compared with limits of 215 F. for polyvinyl dichloride, and 250 F. for chlorinated polyether.

Principal uses for the pipe are expected to be in service above 200 F., for such corrosive fluids as hydrogen fluoride, hydrochloric acid, ferric chloride slurries, caustic soda, wet chlorine and chlorine dioxide, nitric and chromic acids, chlorinated aliphatic and aromatic solvents, nitrogen tetroxide and hydrazine in storable propellant systems.

Engelhard Industries, Newark, N. J., announced it has developed methods for producing fused silica in 3-ton blocks. Large blocks lead to fabrication savings of as much as 50% in fused-silica equipment liners, since sheets up to 50 in. long, 40 in. wide and 6 in. thick can now be made.

Among applications for fusedsilica liners: in chlorination processes, acid towers, and mixing and storage tanks. Silica beams can also be fabricated to support tower packings, and disks up to 40 in. dia. can be cut for base plates.

Southwestern Engineering Co., Los Angeles, introduced a new 60in.-dia. high-capacity vibrating screen separator with three-dimensional movement. Unit is claimed to have greater separating efficiency and higher throughput per square inch of surface than any other screening device. It handles wet or dry, fine or coarse, heavy or light material. Screen life is said to be unusually long; spacing frames and screens can be changed quickly. Lack of transmitted vibration allows unit to be set in

place without special foundation.

an

Haveg Industries, Inc., Wilmington, Del., displayed a 4,300-gal tank-truck body fabricated from glass-fiber-reinforced polyester. The vehicle costs about the same as a rubber-lined steel tank but weighs 25% less, allowing greater payload. Haveg has also developed a method for bonding polyvinyl chloride to the polyester, allowing this construction to be used for chemicals that would ordinarily attack polyester.

Zeta-Meter, Inc., New York, disclosed that its unique line of zeta-potential meters (Chem. Eng., June 26, p. 121) is going to be used in municipal sewage treatment for the first time. The city of Norwich, N. Y., is said to be saving \$500,000 in a new plant by eliminating need for secondary sewage treatment, instead is using zeta-potential control to optimize floc-treatment.

For more information about the last two developments, see *Chementator* in this issue.

Grain-Derived Alcohol Gets Capacity Buildup

A new furfuryl alcohol plant, scheduled for completion in the first quarter of 1962, is being built in Omaha, Neb., by The Quaker Oats Co.

This will be the third such unit for the company (which is the only producer of the material in this country) and will double its capacity for the product. The new unit will also free some of the hydrogenation facilities at the firm's Memphis, Tenn., plant, allowing increased production of tetrahydrofurfuryl alcohol and other hydrogenated products.

The new alcohol plant will hydrogenate furfural from grain byproducts via a unique low-pressure process. Major use for furfuryl alcohol is in foundry-core binders, where in combination with urea it forms a fast-curing (10-20 sec.) hotset binder for sand molds. It is also being used in carbon-impregnating solutions and in binders for carbon.

Honeywell announces the NEW series

n.

ing-

gal.

rom

ter.

ame but

iter

ped

nyl

ing

for

at-

listaine in the ch, 000 ed int, on-

1e

lt

er

The addition of the new Series 1400 valve body to the Honeywell line of control valves now gives you a choice of actuator-body combinations to match your applications. Now you can choose the exact type and degree of control you need, without pushing a valve beyond its design limits ... or without paying for more performance than you need.

The compact Series 1400 valve body is available in a full range of materials, ratings and sizes, with screwed or flanged ends. It can be used to regulate small flows in process, pilot plant, research and commercial control systems. Each body size ($\frac{1}{2}$ ", $\frac{3}{4}$ " and 1") has a wide range of reduced ports with Cv's from .025 to 11.0. Two bonnet constructions facilitate mounting of five types of actuators — three pneumatic and two electric.

Each actuator-body combination fits a different range of operating conditions and performance characteristics, but with sufficient overlapping of these ranges to give you a wider selection on the basis of cost. For complete details, write for Bulletin B803-1. MINNEAPOLIS-HONEYWELL, Fort Washington, Pa.



HONEYWELL INTERNATIONAL Sales and Service offices in all principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

Processes

Thick cadmium coatings, applied by a new vacuum-coating process, are being applied to high-strength alloy steel aircraft parts by a vacuum coater developed by NRC Equipment Corp., Cambridge, Mass. Vacuum metallizing with cadmium not only provides corrosion resistance but also avoids weaknesses introduced into steel by hydrogen embrittlement during conventional cadmium electroplating processes.

In the NRC process, cadmium is evaporated from special "boats" in a vacuum chamber via electrical heating. Cadmium vapor then condenses on the clean steel parts. Length of evaporation time, plus other variables, controls thickness of coating from 0.0002 to 0.0006 in.

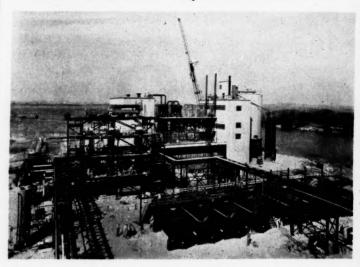
Electrolysis of solid quartz can remove energy-absorbing impurities from quartz crystals so that they can be used in high-temperature resonators for frequency-controlling devices, reports Bell Telephone Laboratories. New crystals can operate as high as 1,020 F., compared with a limit of about 480 F. for conventional crystals. This could have special importance for electronic devices in missiles

Bell's treatment consists of impressing an electric current at about 500 v. across a quartz crystal for about 24 hr. at a temperature of 930 F. Under these conditions, impurities such as sodium and lithium are swept out of the crystal, allowing it to vibrate at much higher temperatures, with little energy dissipation.

Plants

Borg-Warner Corp.'s Marbon Chemical Div., will build a 75-million-lb./yr. styrene plant at Baytown, Tex., adjacent to Humble Oil & Refining Co.'s refinery. Under the terms of a contract announced by Enjay Chemical Co., a division of Humble, ethyl ben-

Dixon etches niche in hydrofluoric acid ranks



Dixon Chemical Industries Inc.'s first step into fluorine chemistry is this 11,000-ton/yr. hydrofluoric acid plant at Paulsboro, N. J., making Dixon the twelfth U. S. producer of the chemical. Buss Ltd., Basel, Switzerland, provided basic plant design, technique, and assembly teams to help install critical process items. Unit will be integrated with Dixon's sludge-burning sulfuric acid plant on the 70-acre site.

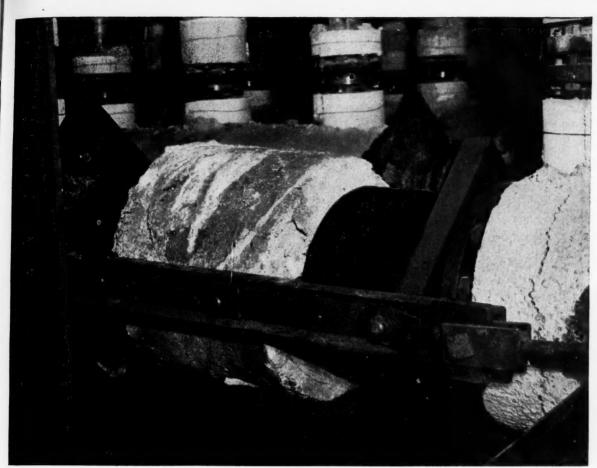
zene feedstock will be piped from the Humble refinery to Marbon. The latter will convert it to styrene monomer, ship that to its plastics-producing plants in Gary, Ind., and Parkersburg, W. Va. Construction at Baytown will begin by the end of the year, be completed early in 1963.

Texas Alkyls, Inc., a joint enterprise of Hercules Powder Co. and Stauffer Chemical Co., has quadrupled aluminum alkyls capacity at Houston. Original design capacity of the plant was 1 million lb./yr., but when the first unit came on stream in 1960, output was jumped to 2 million lb./yr.; now, facility can turn out 8-10 million lb./yr. Expansion adds a long list of aluminum alkyls (including isoprenyl aluminum, tri-n-butyl aluminum, diisobutyl aluminum hydride, diethyl aluminum chloride, methyl and ethyl aluminum sesquichlorides) to the two original products (triethyl and triisobutyl aluminum).

Freeport Sulphur Co. plans to add a second production platform to its enormous Grand Isle, La., offshore sulfur mine, 7 miles off the Louisiana coastline in the Gulf of Mexico. Already the largest steel island in the Free World, platform will measure 4,076 ft.-four times as long as the Queen Elizabethwhen the addition is completed in 1963. Goal: to drill 108 new sulfur wells in the ocean floor, 50 ft. down from the 1,500-ft. platform extension. To cost \$3.5 million, addition will boost investment to a total of \$30 million.

Tidewater Oil Co. plans a 32-million-cu. ft./day natural gas processing plant in Normanna, Bee County, Tex. Hudson Engineering Corp. will build the facility, beginning construction about March and planning completion in May. Design capacities: 63,000 gal./day of ethane-propane mixture, 15,000

CPI News Briefs continue on page 114



Sixty 10, 12 and 14 in. Zallea Expansion Joints absorb expansion in lateral headers, and deflection due to downcomer expansion.

WHEN TEMPERATURES ARE REALLY HIGH, YOU NEED THE

maximum reliability of Zallea Expansion Joints!

These expansion joints are so hot they glow. Yet, 60 of them have been in service for over 7 years without a single failure! The temperatures are so high (our customer prefers not to say just how high, but the cherry-red glow will help you guess), that spares were purchased for the job in anticipation of short expansion joint life. The spares? They are now in similar service at a newly expanded facility.

This is just one more example of customer confidence created by Zallea performance...the kind of performance you can expect when Zallea design and application specialists sit down with your engineers to tackle a tough expansion joint problem.

Our work with virtually every engineering and manufacturing firm in the process field has given us an unequalled background of experience and engineering capabilities . . . experience that can save you time and money when it is brought to bear on your specific problems.

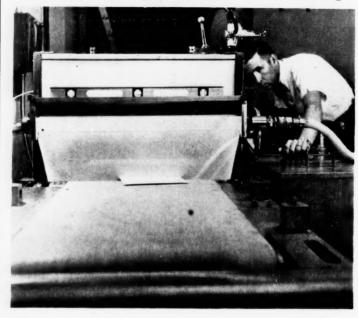
Write for Catalog 56. It contains comprehensive engineering data for expansion joints from 3 in. to 50 ft. dia., pressures to 3600 psi, temperatures to 1600 F...Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.



WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS

ple

Paperboard gets polyvinylidene chloride coating



This sheet of bleached board is passing through a coater applying a thin but continuous film of Resyn 3600, a polyvinylidene chloride water-based system that imparts unusual barrier properties to paperboard surfaces.

The latex can be applied at low-coat weights on various substrates with curtain-coating equipment. Continuous films, easily formed at room temperature, will protect the substrate from strong acids, alkalis and most common solvents. When applied to paperboard products, Resyn 3600 also prevents transmission of moisture, gases and greases.—

National Starch and Chemical Corp., New York.

Epoxy lacquer

"One-can" epoxy systems hinge on the resin's long polymer chain.

Last month, at the Paint Industries Show in Wash., D. C., Shell Chemical Co. introduced the first epoxy resin that doesn't require any catalyst during cure.

It is a standard epoxy formed by reacting bisphenol-A and epichlorohydrin. Yet, without crosslinking, it can form coatings of unusual adhesion and toughness because it has the longest polymer chain (average mol. wt. 200,000) of any epoxy available.

Called Eponol 55, the compound can only be used as a lacquer. Dissolved in a suitable solvent, it forms a coating by solvent evaporation alone. The high bonding power of the resulting lacquer film comes solely from the resin's high molecular weight and linearity.

Shell reports that coatings made with Eponol 55 have outperformed vinyl, chlorinated rubber and nitrocellulose lacquers. Hardness, flexibility, abrasion and chemical resistance are typical properties of the new system. Single coats, either clear or pigmented, are often all that is required for protection of metal products.

Two solutions are presently on the market: Eponol 55-B-40, containing methyl ethyl ketone, and Eponol 55-L-32, containing Cellosolve acetate. They are aimed at the automobile market, but these lacquers will also be available in aerosol cans at retail stores. Both sell for about 50¢/lb.—Shell Chemical Co., New York.

42B

be

an

ove

to

tion cro

pro

ing

hav

wit

Th

but

pli

nai

car

2111

oth

pol

the

chi

str

lic

tic

m

ge

gl

th

ar

fo

it

3

oi

pl

Dyeing aid

Water-soluble liquid is effective in dyeing nylon and wool.

Lanamol CW, a clear, viscous liquid with acidity at pH 4, is a new dyeing aid for wool and nylon fabrics. Soluble in water in all proportions, this product boasts excellent wetting qualities and dye penetration even upon shrinkage.

Application is simple. For dyeing wool, Lanamol CW is used with ammonium sulfate in a neutral or weak acidic bath (pH 4-6). Scoured wool is wet out completely in a bath containing 1% Lanamol and 1-3% ammonium sulfate or acetate. The desired dye is then added as a solution into this bath and the temperature is slowly raised to the boiling point for $\frac{3}{4}$ -1 hr.

A similar procedure is used for dyeing nylon 6 and nylon 66. Here, the scoured fabric is wet out for 5 min. After the dye is added, 1-3% Lanamol CW and 10% ammonium sulfate are mixed into the bath, which is first run cold for ½-hr. and then slowly heated to boil for about 1 hr.

Product is reported to offer full and level dyeing, and complete dye exhaustion. Because of its freezing point of -15 C., Lanamol can be safely shipped and stored during winter months.—Allied Chemical, National Aniline Div., New York.

Acrylic coating

Thermosetting finish cures rapidly under intense infrared radiation.

Curable in as little as 24 sec. with specially designed infrared heating equipment, Duracron promises excellent resistance to chemical corrosion and weathering.

Under normal conditions, such an acrylic polymer would have to be cured for 30 min. at 350 F. in an enclosed gas-fired convection oven or receive 60-70-sec. exposure to 650-F. air. But exposing the organic coating to infrared radiation (wavelengths from 2-4 microns) can cut curing time to 24 sec. without affecting coating properties.

986

in

th

m.

 ^{2}B

in

18

a

n

11

S

r

Chemically, Duracron is a coating composed of an acrylic compound (to which side-chain amides have been attached) copolymerized with styrene and ethyl acrylate. The polymer system is suspended in an aromatic solvent mixture of butanol, xylene and toluene.

Duracron coatings can be applied to metal siding, metal wall partitions, curtain walls, metal cans. It can also be used as an automobile enamel that, unlike other enamels, can be buffed and polished to remove blemishes from the painted surface. Resistance to chipping is claimed to be high.

In coatings on metal siding or strips, costs for Duracron are about 0.8¢/sq. ft. — Pittsburgh Plate Glass Co., Pittsburgh. 42D

Germicide

Anhydrous new germicide in liquid form also acts as deodorant.

Hyamine 3500, a straw-amber liquid consisting of an 80% solution of alkyl dimethylbenzyl ammonium chloride in ethanol, is reported as an exceptionally effective germicide in hard water.

Miscible in all proportions with water, ketones, lower alcohols and glycols, this compound goes into the preparation of liquid disinfectants used in homes, hospitals and food processing plants. Because of its anhydrous nature, Hyamine 3500 can be incorporated in floor oils and waxes. Other possible applications include germicidal air filters and aerosol sanitizers; algaecides and slimicides for swimming pools, industrial water reservoirs, and water-cooled heat exchangers.

The product is partially soluble (30%) in aromatic hydrocarbons, and can be coupled into aliphatic hydrocarbons by a suitable dis-

solving agent such as imidazolium bromide. Density is 7.75 lb./gal., and the product is sold at $45\frac{1}{2}\phi/lb$. in tank-car quantities. Hyamine 3500 will crystallize after prolonged storage at low temperature, but will return to the liquid state at room temperature. — Rohm & Haas Co., Philadelphia.

Polvesters

Family of six resin formulations fills widely varying demands.

Six polyester resins of the same family—Selectron 5119, 5834, 5158, 5084, 5872, 5875—have been introduced to fill generally similar, but individually slightly different, specifications. Sparked by the promise of widespread polyester use in glass-fiber-reinforced vessels, all six are tough, corrosion-resistant, moldable, single-additive formulations.

► Selectron 5119 — The general-duty standby of the series, #5119 fills needs of several applications. Gel time is flexible. The product cures at room temperature, but also cures at uncommon extremes, which may depend on the thickness of the layer applied, gel time, catalyst concentration, and other factors (sample cures: 7 min. at 220 F.; 60 days at 77 F. and 0.2% catalyst; 72 hr. at 77 F. and 2% catalyst).

Glass-fiber-reinforced sections can be molded from #5119 with no pressure, slight pressure, or up to 10-15 psi. (as in bag molding). Closed molds may be used, or molds with one surface exposed to the air.

Selectron 5119 wets glass fibers but is sufficiently viscous to hold runoff to a minimum on vertical surfaces. It cures to a hard, tough, tack-free, rigid material that can be handled and sanded—in some cases, within an hour after gelation. As a general rule, a temperature hike of 18 F. cuts gelation time in half and an 18 F. temperature drop doubles it. Recommended catalyst is methyl ethyl ketone peroxide.

► Selectron 5834 — Retaining the basic characteristics of #5119, Selectron #5834 adds the property of thixotropy—the ability of some gels to become fluid when shaken, a reversible change. Its thixotropic property makes for easy application on vertical surfaces and over difficult mold contours.

A low-viscosity polyester, #5834 exhibits a wide range of gel times, minimum of drainage from impregnated mat and cloth in vertical positions, excellent uniformity of gel and cure properties, and the absence of spotting in a thick laminate that uses up to 0.5% catalyst concentration.

► Selectron 5158 — A moderately reactive and fast-curing molding resin, #5158 has exceptional impact and modulus properties. Excellent wet-strength retention and good weathering characteristics are coupled with crack-free moldability and surface gloss. Not recommended for room-temperature curing, it may either be molded as

Newsworthy Chemicals

Page number is also reader service code number

Polyvinylidene chloride is coated onto paperboard42A
"One-can" epoxy systems are available42B
Water-soluble dyeing aid works on nylon, wool
Acrylic coating cures in as little as 24 sec42D
Anhydrous germicide also acts as deodorant
Six polyester resins are of the same family
Lubricant is combination of slippery Teflon, MoS ₂
Polyethylene piping can be extruded faster44B
Diheptyl p-phenylene diamine is sweeting catalyst44C
Epoxy plasticizer is economical for vinyl makers
Crystalline silica comes highly pure44E

-For more details use Reader Service Card-

is or thinned with up to 15% styrene. Catalyst is benzoyl peroxide. ► Selectron 5084—Designed for long tank life with minimum drifting tendency, #5084 has an extended gel state during which it remains soft, flowable, fusable. Featured applications include rod stock, flat-paper-base laminates, preform molding.

5872—An ▶ Selectron opaque white gel-coat resin, #5872 was designed specifically to provide reinforced-plastic products with a tough, durable and attractive surface. Gel coats show excellent weatherability and heat-resistance. Product may be brushed on, although a spray system is recommended. Suitable spray conditions are pot pressures of 25-50 psi., atomization pressures above 50 psi. Catalyst is methyl ethyl ketone peroxide. Again, gel times are flexible.

► Selectron 5875—A neutral gelcoat resin, #5875 may be pigmented with one of several Selectron color concentrates for
reinforced-plastic products with
tough, durable and attractive colored surfaces. Like #5872, this one
may also be brushed on although
spraying is preferable. Spray conditions duplicate those of #5872.
—Pittsburgh Plate Glass Co.,
Pittsburgh. 43B

Lubricant

Lowest friction is achieved by combination of MoS₂ and Teflon.

Lockrey Co. has just introduced a lubricant that successfully combines MoS₂ and Teflon, two of the most slippery substances known.

Marketed under the trade name Molynamel E, the lubricant can be dipped, brushed or sprayed on any surface with or without primer. The resulting coating — which dries overnight at room temperature—has an extremely low coefficient of friction, and is unaf-

For more information about any item in this department, circle its code number on the Reader Service Postcard (page 145)

Readers' choice

Reader service inquiries provide a handy guide to new chemical items that most interest you, the reader—and an unpredictable group you are. To let you know which chemicals interest you most, the ones that were rated tops by you over the past year will be featured in a special roundup in this department next issue.

—ED.

fected by most solvents except esters and ketones. The room-temperature cure is in contrast to the 600-700 F. bake normally required to fuse a Teflon dispersion coating.

Molynamel E may be applied to metals, wood, rubber, plastics, ceramics and glass. For carrying heavy loads, coatings may be baked with lamps or in an oven at 300 F. for 1 hr., or at lower temperatures for longer exposure periods, depending on the heat that the substrate material will stand.

Test have shown that lubrication action is continuous from 400 F. down to the cryogenic region. Adhesion and resistance to wear and corrosion are better than Teflon alone. Also, the product maintains its lubricating action under extremely heavy loads because of Teflon's tendency to fuse and redistribute itself, and molybdenum disulfide's load-carrying ability of 250,000 psi.—Lockrey Co., Southampton, N. Y. 44A

Polyethylene

Plastic piping becomes stronger, can be extruded faster.

A new high-density (0.956) polyethylene, Bakelite DGDB-3044, is now compounded specifically for pipe extrusion. Because of a low melt index of 0.2, this polyethylene is extruded 10% faster than other high-density grades, and offers long-term burst strength. (Pipes tested at room temperature for 1,000 hr.—at hoop stresses of about 1,700 psi.—showed no evidence of failure.) Approved by the National Sanitation Foundation for transportation of potable

water, DGDB-3044 pipe displays glossy internal and external surfaces. Free from scale buildup, the pipe is resistant to most corrosives as well as to rupture from freezing. The plastic's brittle temperature is -98 C.

According to the manufacturer, the pipe is flexible enough to allow easy coiling, and strong enough to withstand rough treatment during installation and service.—Union Carbide Plastics Co., New York.

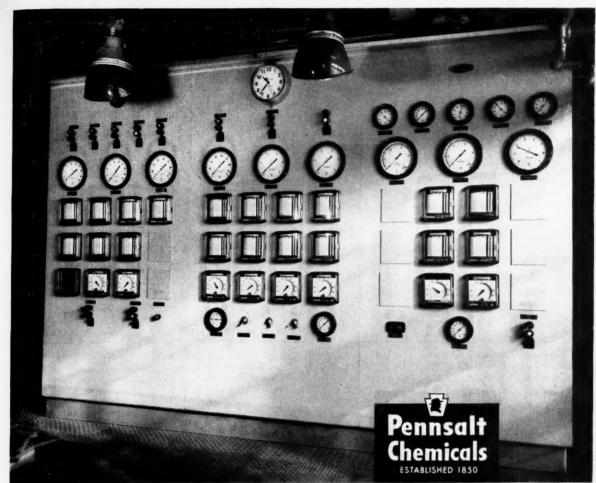
Briefs

Diheptyl p-phenylenediamine is the latest sweetening catalyst and gum inhibitor for gasoline. Called Tenamene 4, this amine compound sells for 83¢/lb., and when used at a concentration of 5 lb./1000 bbl. of gasoline, is particularly effective in lowering the mercaptan sulfur content. It also delays formation of insoluble polymers and gums that come from oxidation of unsaturated hydrocarbons in stored gasoline.-Eastman Chemical Products, New York.

Epoxy plasticizer, Flexol GPE, combines the heat and light stabilization characteristics of epoxy plasticizers with the low-temperature flexibility and compatibility that are needed in vinyl plastics. This product is reported economical for vinyl producers because it can be used at about the same concentrations as higher-priced epoxy esters and adipate plasticizers. Flexol GPE has a price range of $31\frac{3}{4}-34\frac{3}{4}\frac{4}{7}$ lb. — Union Carbide Chemicals Co., New York.

Crystalline silica, tradenamed Min-U-Sil, is a high-purity material used as filler in silicone rubber, epoxy and polyester resins, paints, cements, cleansers and polishes. It can also replace conventional silica in vitrified ceramics, increasing the strength while reducing the weight of ceramic ware. The new silica is available in 5-, 10-, 15- and 30-micron size.

—Pennsylvania Glass Sand Corp., New York.



AAA CONTROL SYSTEM

Photo above shows Taylor Transcove Indicators and Recorder-Controllers on a central control panel for Alkyl Alkanol Amines production at Pennsalt Chemical Corp.'s new plant at Wyandotte, Mich.

Alkyl Alkanol Amines produced at Pennsalt Chemicals' new plant in Wyandotte, Michigan are used in the manufacture of local anesthetics, antihistamines, textile lubricants, ion exchange resins, and emulsifiers for wax polishes. To assure the amines produced are of the high quality required for these uses, the new AAA process equipment, recently installed, features TRANSCOPE® Recorder Controllers by Taylor.

ys rp, rm r, w to g

The plant, designed and constructed by Catalytic Construction Company, utilizes 21 TRANSCOPE one and two-pen Recorders; 13 TRANSCOPE Indicators; and 23 TRANSCOPE Controllers to record and control flow, pressures and levels.

Taylor's Servo-Powered TRANSCOPE Electronic (700J series) and Pneumatic (90J series) Recorder Controllers convert input signals to records of unprecedented accuracy — ½ of 1% with standard instruments; ¼ of 1% optional. They also give threshold sensitivity of 0.1% of input signal; a pen-mounted, three-month ink supply; and a truly rectilinear chart — no curved time lines.

Ask your Taylor Field Engineer for details on these and many other features of TRANSCOPE servo-operated recorders. Or write for **Bulletin 98286** (pneumatic) or **98335** (electronic). Taylor Instrument Companies, Rochester, N. Y., and Toronto, Ontario.

Taylor Instruments MEAN ACCURACY FIRST

	TYPICAL	PROPE	RTIES	OF SH	IELL T	OLU-S	OL TH	INNER	5	
Tolu-Sol	5	10	15	20	25	30	35	40	45	50
Distillation °F.										
(ASTM D-86)										
IBP	199	199	199	199	200	203	204	204	205	205
Dry Point	215	217	220	222	223	227	228	230	230	231
Specific Gravity										
60°/60°F.	0.699	0.714	0.721	0.729	0.734	0.747	0.751	0.761	0.769	0.78
Composition, %v										
Paraffins	88	82	77	73	69	64	60	56	51	46
Naphthenes	9	8	8	7	7	6	6	5	5	4
Aromatics	3	10	15	20	24	30	34	39	44	50
Absolute Viscosity										
centipoise @ 77°F	0.41	0.41	0.41	0.42	0.42	0.43	0.44	0.44	0.45	0.46
Aniline Cloud										
Point °F.	148	134	123	114	107	93	86	75	64	55
Nitrocellulose										
Dilution Power*										
(ASTM D-1134)	1.22	1.32	1.40	1.49	1.53	1.62	1.68	1.76	1.84	1.92
			*Also know	vn as Lacque	Dilution Ra	itio				

Comparison chart shows how range of solvency of Tolu-Sol family widens the choice of diluents for your formulations. If an intermediate grade is needed, ask Shell to make it for you.

For help in choosing the grade that gives the optimum combination of properties and cost for your formulations, call in your Shell Industrial Products Representative.

BULLETIN:

Shell announces a large new <u>family</u> of Tolu-Sol thinners that allow you to choose the <u>precise</u> <u>solvency</u> you need

From today, the name Tolu-Sol® applies not to one product, but to a complete family of hydrocarbon solvents.

Shell's new Tolu-Sol family is characterized by extremely lownaphthene content and closely controlled aromatic content. The family has a wide range of solvent power—but similar volatility. Here are the facts.

Now you can select precisely the right solvency for your needs from a family of thinners with similar volatility but different solvent power. Shell makes this flexibility possible

with its new Tolu-Sol family.

The composition of these thinners is characterized by a low naphthene content and a closely controlled aromatic portion. Within the family, the aromatic content varies from less than 5 per cent to about 50 per cent.

pre

clo

How to identify each grade

The percentage of aromatics identifies the grade of Tolu-Sol. Thus, Tolu-Sol 10 contains approximately 10 per cent aromatics. Tolu-Sol 50 has approximately 50 per cent aromatics.

The Tolu-Sol you have known for years is now called Tolu-Sol 25.

TOLU-SOL BULLETIN (CONT.)

And it now has a higher aromatic content and better odor.

To develop this new family of solvents, Shell scientists adopted a manufacturing technique that gives more precise control over the composition of each of the Tolu-Sol grades.

Controlled composition

The naphthene content is kept low, because naphthenes, despite their high KB numbers, have relatively poor viscosity reducing power. However, aromatics have high solvency and good viscosity reducing power.

Shell carefully controls the proportions of aromatics in each grade of Tolu-Sol.

Aniline cloud points and lacquer dilution ratios show that the Tolu-Sol diluents will provide the solvency you expect.



Scientist in Shell Laboratory measures lacquer dilution ratios of Tolu-Sol. Ratios range from 1.22 to 1.92.

Greater uniformity

The Shell manufacturing technique produces thinners with dependable properties.

This new Tolu-Sol family can give you greater flexibility in establishing your own formulations.

es

nt

xi-

NG

Here, Shell discusses four important features of the new Tolu-Sol family.

1. Compatibility. The full family of Tolu-Sol thinners covers a wide range of solvencies (see chart). Aniline cloud points range from 148°E to 55°E.



Range of solvencies of new Tolu-Sol family covers wide range of formulation requirements. Example: Low-aromatic Tolu-Sol 10 is ideal thinner for traffic paints and rubber cements.

and lacquer dilution ratios range from 1.22 to 1.92.

- 2. Volatility. The Tolu-Sol family has similar volatility with only small differences in evaporation rates.
- **3.** Viscosity. All grades of Tolu-Sol have an unusually low naphthene content. Because of this, Tolu-Sol thinners have very low viscosities for their respective solvency ranges.

Their lower solvent viscosities can lead to lower finished solution viscosities. Or, at the option of the user, higher solids content with the same finished solution viscosities may be possible.

4. Odor. Because they are so highly refined, Tolu-Sol thinners have exceptionally low bulk odor and residual odor.

Wide distribution

Shell's new Tolu-Sol family is available now for delivery to all areas east of the Rockies.

Memo to West Coast formulators

New family of Tolu-Sol diluents is not yet available on the West Coast. There, Tolu-Sol W will retain the dependable properties you are accustomed to.

For complete information on Shell Tolu-Sol thinners, see your Shell Industrial Products Representative. Or mail the coupon below.

A BULLETIN FROM SHELL

—where scientists are working
to provide better products for industry

Shell Oil Company, 50 West 50th Street, New York 20, New York Please send me a free copy of your Technical Bulletin No. SP-61-2 on the new family of Shell Tolu-Sol diluents. Name Title Company Street City Zone State

TWO AGITATORS ON SAME SHAFT STIR THINGS UP

Violent action in mixing zone produces particle-toparticle impingement, reducing wear on equipment and shortening mixing time.

Last month, this department presented a mixer that used two counter-rotating agitators to exert a high shearing force, with a minimum of circulation, on the material being mixed (Chem. Eng., Nov. 27, p. 74).

Here is another mixer with two agitators, both on the same shaft, that obtains a high shearing force by using a maximum of circulation to promote particle impingement. Various models perform wet and dry blending.

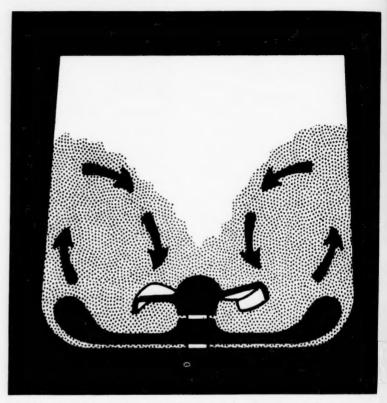
Energy is imparted to the mixture by means of a centrifuging agitator that sweeps the bottom of the vessel and projects the mixture upward and outward. Located above it, a suction agitator or impeller pulls the material downward and thrusts it into the active mixing zone.

The result: aided by a conically contoured vessel, the material develops high shear force by particleto-particle friction that gives intense mixing with minimum wear on the agitator system.

▶ Dries While Mixing—Since the energy from the agitators is transformed into heat, a simultaneous drying of moist materials can readily be achieved. The turbulence pattern inside the vessel leaves a void, permitting the insertion of a vacuum tube to assist drying of the charge.

The unit can be supplied with heating and/or cooling jackets for steam, oil or water circulation. Cooling is particularly important for products that tend to agglomerate when overheated.

For particular applications, the mixer operates under pressure or vacuum. If desired, a thermocouple can be built into the tip of a ma-



Centrifugal agitator pushes material out, up; impeller thrusts it down.

terial-flow baffle (which determines flow pattern inside the unit) for immediate reporting of the temperature of the mix.

Other additions that can simplify operation of the equipment are an illuminated sight port and pneumatically operated lids and discharge ports. Electric drive motors are generally supplied in two-speed design; however, single-speed and variable-speed units are available.

Working capacity ranges from 0.2 to 15 cu. ft. Smaller models are available in all-stainless steel construction, while larger units can be provided in mild or stainless steel. ► Combination Unit—For special applications such as dry blending of vinyl resin, a combination unit is employed that consists of a twostage mixing system.

The upper vessel is jacketed for heating and contains pneumatically operated lid and discharge ports. Resin, plasticizer and additives are blended until temperature rises to a preset level, when the mixture is automatically discharged into a second, cooling, mixer via a flexible connection.

The mixture is cooled while being agitated by means of both a cooling jacket and a water-cooled agitator. The cooling cycle is matched to the hot preblend cycle so that when the cool, nonagglomerating product is discharged, another hot charge is ready.

► And Wet Mixing, Too—Still, another type of mixer is provided for blending of liquids. It develops less energy input than the dry unit, comes in seven sizes with working main

One

colun

Carb

opera

tem i

adsor

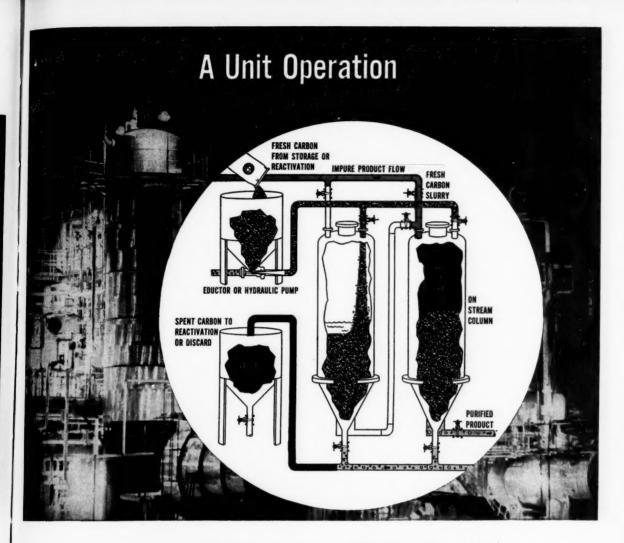
produ

ate h

Ba

CHEN

48



...accomplished more efficiently with Pittsburgh Activated Carbon!

One of the really unique advantages of a continuous column adsorption system, utilizing Pittsburgh Granular Carbons, is that it functions as an engineered unit operation. Pittsburgh Granular Carbon in a column system is one continuous operation that provides maximum adsorption efficiency and can be added to your present production system with relative ease.

Batch-type slurry tanks, filter presses and intermediate handling equipment, with their inherent high cost maintenance, are eliminated.

BASIC DESIGN

to

For Continuous Column Adsorption Systems

Write For Free Brochure

This brochure illustrates basic design techniques for both liquid and vapor phase, continuous column adsorption systems. Please write for your free copy . . . there's no obligation.

Pittsburgh Activated Carbon in a column series facilitates a *cleaner* operation, too, with no dust or slurry problems . . and, more important, you realize greater product yield, utilize less carbon, and, in turn, *significantly reduce adsorption costs*.

If your adsorption process involves decolorization, purification, deodorization or catalysis, investigate Pittsburgh Granular Activated Carbon. Put these advantages to work in your processing operations to help you produce an even better product . . . at lower cost.

ACTIVATED CARBON DIVISION



PITTSBURGH CHEMICAL CO.

GRANT BUILDING PITTSBURGH 19, PA.

A Subsidiary of PITTSBURGH COKE & CHEMICAL CO.

capacities from 0.3 to 35 cubic feet.

Available in stainless or mild steel, the wet mixer can be supplied with a cooling and heating jacket. Standard jacket can accommodate 45-psi. steam, but jackets for higher temperatures are available for operations that involve cooking.

The unit can also be supplied for operation under pressure or partial vacuum.

Called the Papenmeier mixer, the unit in all its forms is imported from West Germany.—Welding Engineers, Inc., Norristown, Pa. 48A

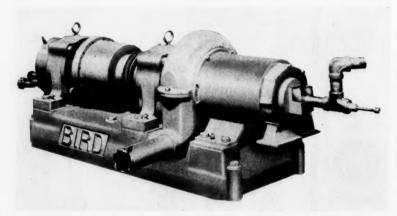
through nozzles attached to the conveyor hub; the liquid leaves the bowl with the clarified mother liquor.

► Clean Operation—One of the unit's advantages is that the entire operation is performed completely under cover, and the separation is accomplished entirely by centrifugal sedimentation, requiring that no filter medium be cleaned or replaced.

The device is constructed in a cantilever fashion so that only the portions coming in contact with the products need be handled during cleaning. The drive portion remains undisturbed.

This feature promotes processing of materials where bacterial or other types of contamination require cleaning to the point of complete sterilization; and for research and pilot-plant operations where several different types of materials may be tested each day.

The machine is designed to operate at speeds up to 6,000 rpm. Shear-pin protection is incorporated to guard against damage should feed-rate control become erratic. Type 316 stainless steel is the standard material for the bowl, conveyor, feed pipe and housing, although other materials may be supplied on special order.—Bird Machine Co., South Walpole, Mass. 50A



LITTLE CENTRIFUGE; BIG OUTPUT

Suitable for pilot-plant or industrial service, this continuous rotating-bowl unit has a large capacity range, the same features as its larger counterparts, and now works under pressure.

Here's a continuous centrifuge for pilot-plant or production service that performs like its larger counterparts, except that it has a bowl diameter of only 6 in., compared with up to 54 in. for the others.

The horizontal unit can handle from 0.1 to 10 gpm. of synthetic resins, food products, pharmaceuticals, mineral slurries requiring classification or dewatering, and a variety of solid-liquid separations. Internal wash of the solids is possible.

And like most of the larger machines, the 6-in. unit can now be operated under pressure up to 70 psi. over its entire speed range. Inert gas used in the seals prevents slurry

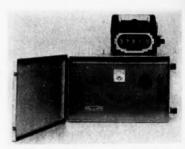
vapors from escaping during operation.

▶ How It Works—The device consists of two concentric rotating elements surrounded by a stationary housing. The outer element is a solid-wall bowl, shaped so that solids discharge from a smaller radius than the liquid does; the inner element is a hollow-hub screw conveyor whose blade tips fit closely to the bowl's contour.

Feed slurry, introduced within the conveyor hub, is accelerated to machine speed, then delivered centrifugally through ports into the solid bowl. A gear unit maintains a small constant speed differential between the bowl and conveyor.

Solids settle through the liquid to the bowl wall by centrifugal action, then the screw conveyor moves them continuously toward the small end of the bowl and discharges them as cake.

Clarified liquid discharges continuously from the other end of the bowl over adjustable weirs. When desired, wash liquid may be applied



Th

nor

the

car

cor

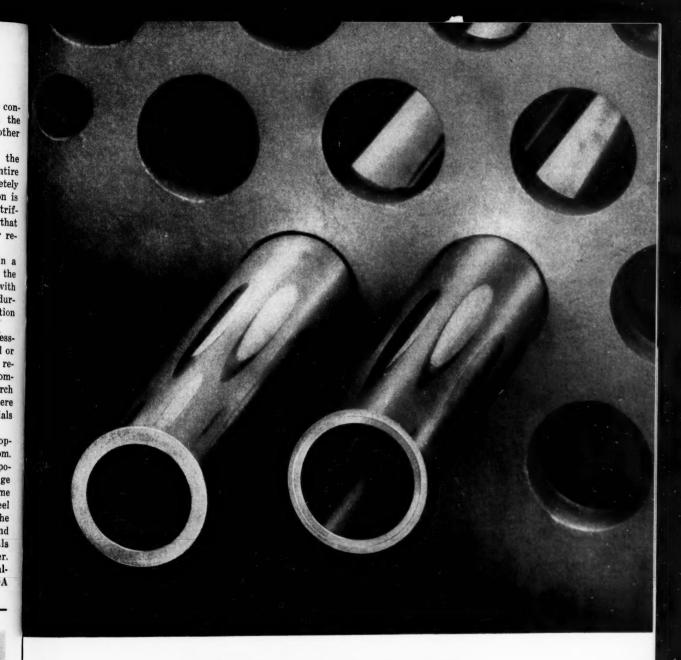
Co

В

Flow-volume computer

Unit corrects volume for variations in specific gravity and temperature.

This flow-measurement system for liquefied petroleum gas (LPG) provides continuous readout in barrels, correcting for variations of temperature and specific grav-



Which lasts longer?

The Duplex Tube on the right...it performs more efficiently and economically than single wall tubing in condenser and heat exchanger service.

Duplex tubing lets you choose the best metal to resist corrosion on both the product side and the cooling side. Used either plain or ferruled, Duplex can prevent premature failures and costly downtime.

Bridgeport has successfully fabricated more than 125 different Duplex combinations to solve a wide range of corrosion problems in oil, chemical, power and food processing industries.

For information on how Duplex Tubing can extend the life of heat exchangers and condensers, write for Bulletin 1-N-9 to Bridgeport Brass Company, Bridgeport 2, Connecticut.

BRIDGEPORT BRASS COMPANY Bridgeport



Bridgeport condenser and heat exchanger tubes in over 50 metals and alloys:

INHIBITED ADMIRALTY INHIBITED ALUMINUM BRASS INHIBITED MUNTZ METAL 70-30 CUPRO NICKEL 90-10 CUPRO NICKEL DEOXIDIZED ARSENICAL COPPER INHIBITED ALUMINUM BRONZE RED BRASS ALLOY 77 MERCURY BRASS

.plus DUPLEX TUBES ... in combinations of the above alloys, with carbon or stainless steel, aluminum, Monel,® nickel...or other metals.

ity in the flowing medium. It uses an orifice as the primary flow element and connects to transducers that detect temperature, differential pressure, specific gravity.

Volume reduction or shrinkage is automatically calculated from built-in tables. Said to be more than 99% accurate, the unit has solid-state electronic components for long, unattended service life in the field.

Readout is presented both by visual counter and printed records; telemetered outputs are also available. Compensation for supercompressability is available as an optional feature.—Computers, Inc., Houston. 50B



Hardened control valve

Body, seat and stem tip are made from alloy for abrasion resistance.

For superior abrasion resistance, the body, stem and seat tip of a straight-through control valve are made with a new alloy said to be harder than heat-treated steels.

In addition to high hardness, the alloy has a tensile strength of over 70,000 psi. and greater corrosion resistance than carbon steel.

To minimize impingement from the flowing medium, the seat is parallel to the line of flow. A ground face on the seat and tip

For more information about any item in this department, circle its code number on the Reader Service Postcard (Page 145)

Repeat performance

Over the period of a year, several new equipment items attract considerably more reader inquiries than the average. Last January, we reprinted the ones that you rated tops. The response was so favorable that a similar review will appear in the Jan. 8, 1962, issue.—FCP

provides positive shutoff. Test valves containing the new material reportedly outlasted the valves they replaced from two to five times.

Available in standard sizes and pressure ratings, the hardened valve costs about 20% more than a comparable one of carbon steel.

—Flow Systems, Inc., Newport Beach, Calif.



Drag conveyor

Heavy dependence on plastic parts reduces maintenance, sparking.

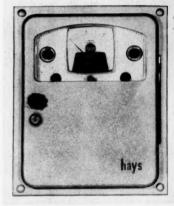
A drag conveyor that cleans itself as it operates is designed to handle all types of dry, free-flowing materials. Its flights are made of either polyethylene or heavyduty neoprene, and the chain-return track is of polyethylene.

This type of construction eliminates metal-to-metal contact except at two points where the chain passes over the sprockets at each end. The result is quiet operation and elimination of sparking in the main part of the system.

The flights are machined to fit

the trough exactly, so that there is a minimum carry-over of materials when different ones are handled. In addition, built-in flight guards prevent detracking of the flights and chain.

The device, which comes in widths from 6 to 24 in., is said to require less horsepower than an equivalent screw conveyor.—Industrial Machinery Co., Inc., Fort Worth, Tex.



Combustibles indicator

Analyzer-type unit finds as little as 1% combustibles in gas mixture.

For continuous analysis in solvent-evaporating ovens, jet engine cells, solvent recovery systems and other applications where undesirable or explosive concentrations of vapors may accumulate, this analyzer-indicator detects combustible gases.

It operates on the principle of catalytic combusion on a heated filament. When a combustible gas passes over the filament, it burns on the surface, increasing filament temperature and electrical resistance. The change in resistance is proportional to the amount of combustible gas present in the mixture.

Combustibles in ranges as low as <1% in gas mixtures are measured with an accuracy of $\pm 2\%$ of range, with a response time of

New Equipment continue on page 120

Polyken tape protects products lines

GAS-OIL SEPARATOR

GATHERING LINES

CRUDE OIL

PETROLEUM REFINERY

e is ials led.

rds hts in to

an Inort

2B



Phillips pipe is cleaned and wrapped by Brodie Construction Company in a single factory-smooth operation. No primer, no drying or cooling. No fumes or fire hazards.

Another convinced user learns the money-saving versatility of one of the world's incredibly tough tapes

for this big

Petro Company

Phillips Petroleum Company chose Polyken No. 960 Extra-Strength Pipeline Tape to protect its products lines. This is why:

- Polyken 960 is a dependable pipeline coating. It is easy to handle, simple to apply, resulting in a reliable, quality installation.
- It is especially suited to construction of short lines and close work, as on these pipelines carrying crude oil fractions.
- It utilizes high-density polyethylene for maximum durability and corrosion resistance.
- It stands up under tough conditions of terrain and climate—experience-proved in many, many thousands of squares installed throughout the world, in plains, deserts, mountains, swamps.
- Its cathodic protection requirements are low.

 AND . . .
- It saves money: Polyken 960 goes on fast with less men per job, covers more miles per day. Less equipment, less handling costs. More savings over the old hot dope idea.

See your Polyken Man...call your Polyken Tape Coating Distributor...or write Polyken, 309 West Jackson Blvd., Chicago 6, Illinois.

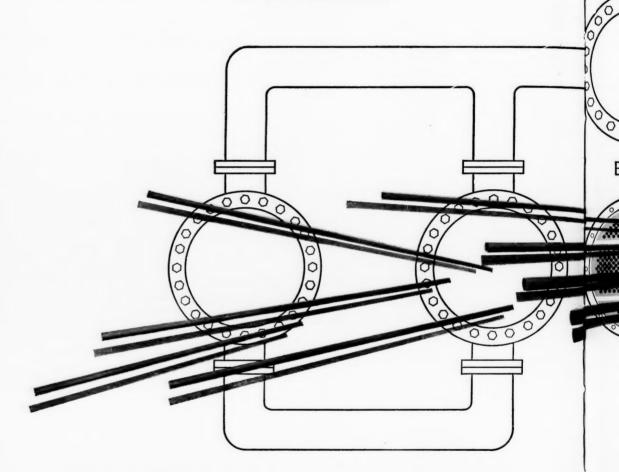
©1960 The Kendall Company

Polyken

EXPERIENCED IN PROTECTIVE COATINGS

THE KENDALL COMPANY
Polyken Sales Division

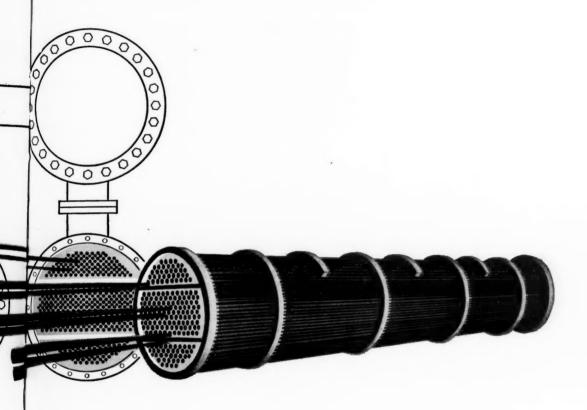
Need tubes for heat exchangers, condensers, evaporators, coolers, feed-water units?



PHELPS DODGE COPPER-BASE ALLOY TUBES have a repu

Wide line of finest quality copper-base alloys for every kind of application need—including bi-metal combinations. National warehouses, completely stocked, in Expert Houston, Beaumont and Corpus Christi, Texas, Baton Rouge and Lake Charles, La., Tulsa, Los Angeles, and South Brunswick, N. J., to serve cus tomers from coast to coast.

.



reputation for reliable "On-Stream" Performance!

exast problems, select the exactly correct alloy for your, Los applications.

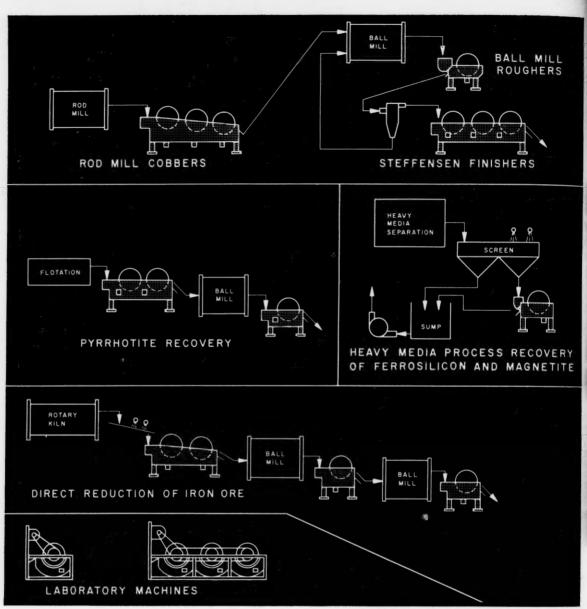
Specify the best-at the same cost as the rest!

cus-

PHELPS DODGE COPPER PRODUCTS

CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge,
Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Des Moines, Detroit, Fort Wayne, Honolulu,
Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee,
Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond,
Rochester, N. Y., San Francisco, St. Louis, Seattle, Tampa, Washington, D. C.



See Jeffrey on your wet concentration and magnetic recovery problems

Jeffrey magnetic separators are exclusively of the drum type. This offers the advantage of extreme simplicity, since the drum is simply a water-tight cylinder of non-magnetic material. It is the only moving part.

Electromagnets, Alnico and the revolutionary new Ceramic permanent magnets, located within the drum and extending part way around the interior of the drum, are stationary and are supported on the shaft on which the drum rotates. The angular position of these magnets is adjustable to fit the needs of any particular problem.

Jeffrey engineers will assist you in selecting magnetic separators for your applications. Ask for Catalog 945. The Jeffrey Manufacturing Company, 909 North Fourth Street, Columbus 16, Ohio.



be

Do yo

guara produ Temp

It r

tiny p

inner

scale

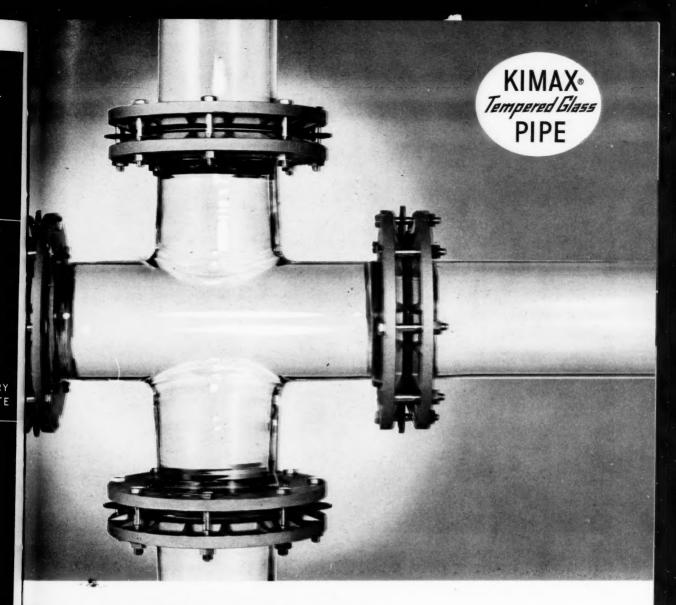
It l

pact o

One of twelve permanent magnet machines efficiently recovering magnetite in a large coal cleaning plant.

If it's conveyed, processed or mined, it's a job for Jeffrey.





Your product stays pure... because KIMAX resists corrosion!

Do your present process pipe lines guarantee the purity of your product? If not, consider KIMAX Tempered Glass Pipe.

It resists corrosion and pitting tiny particles cannot lodge. Smooth inner walls discourage build-up of scale and residue.

It has amazing resistance to impact damage and easily withstands

sudden temperature differentials from steam to cool liquids.

KIMAX Glass Pipe is serenely indifferent to the savage attack of most acids and alkalis.

Since glass is inert, nothing is ever added to or taken away from your basic product.

Stoppages in the line can be spotted in seconds and remedied

almost as quickly and easily.

And KIMAX Glass Pipe is economical . . . initial costs compare favorably with other pipe materials. Installation cost is usually less and maintenance cost is practically nil.

For more information about KIMAX Glass Pipe write Kimble Glass Company, a subsidiary of Owens-Illinois, Toledo 1, Ohio.

Distributed in the U.S. and Canada by Fischer & Porter Company, Warminster, Pa.

KIMAX TEMPERED GLASS PIPE
AN (1) PRODUCT

Owens-Illinois

GENERAL OFFICES . TOLEDO 1, OHIO



An outstanding line of LOUIS ALLIS adjustable-speed drives from ½ to 2500 hp.

Louis Allis offers you a complete line of adjustablespeed drives with various characteristics for every application where adjustable speed is required.

Experienced Louis Allis field engineers, supported by regional and factory industry specialists, will help you select the best drive or drive system to meet *your* requirements.

The Louis Allis line of drives provides outstanding control features ranging from simple manual to precise electronic or transistorized control. Selection of control varies, of course, with the nature of the installation and the precision required. Where desirable, speed regulation as close as .1% is obtainable.

Controls can be provided which automatically respond

to temperature, pressure, or flow. Other control features include threading, inching, jogging, logarithmic acceleration, torque-limit acceleration, tachometer feedback... and many other control provisions that can exactly tailor a Louis Allis drive to *your* operation.

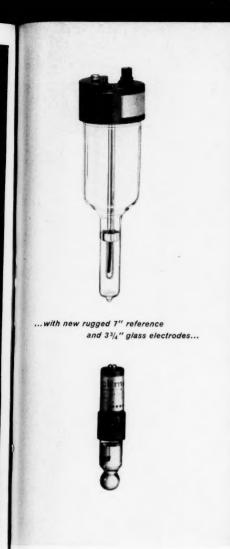
For process plants or applications involving inter-related motors and multiple drives, Louis Allis engineers can provide complete "systems engineering," furnishing all electrical rotating components and control.

For expert assistance, call your local Louis Allis District Office listed in the Yellow Pages under "Electric Motors"...or write direct to The Louis Allis Company, 447 East Stewart Street, Milwaukee 1, Wisconsin. Ask for Bulletin 2900, "Louis Allis Adjustable Speed Drives."

LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVE

TM EATON MEG. CO.





new industrial pH system stresses reliability, flexibility

Beckman, world leader in pH instrumentation, introduces the all-new Model J pH System: compact transistorized analyzer, short, rugged electrodes, and accessory mounting assemblies. Here's continuous analysis equipment which provides reliability, flexibility, and convenience never before possible in industrial applications.

es er-

ly

rs

ng

ct

ic

Check these Model J features, then see your Beckman Sales Engineer or Recorder Company Salesman for complete details, or write for Data File 14-52-06. READOUT FLEXIBILITY. Available with both ma and mv output for use with any potentiometric or current recorders and controllers-or, with mv output only-recorder scale may be expanded to any 2 pH span full-scale. High or low alarm feature may be added.

SOLID-STATE ELECTRONICS. Assures reliability and saves long-term maintenance costs.

QUICK-DISCONNECT ELECTRODES. Short, rugged glass and reference electrodes feature capscrew for quick connect-disconnect of spade lug connectors. Speeds installation and replacement of electrodes.

DRIFT-FREE OPERATION. AC chopper amplification provides stability of 0.01 pH/24 hrs. over a $-20^{\circ} F$ to $\pm 122^{\circ} F$ ambient temperature range. HIGH ACCURACY AND SENSITIVITY. Output accuracy and meter sensitivity is $\pm 0.02 pH$ for full 0-14 pH or 0- ± 1400 mv range.

SIMPLIFIED MAINTENANCE. Plug-in components and circuits, rail-mounted analyzer chassis assure ease of maintenance, reduce downtime.

MINIMUM PANEL SPACE. Compact analyzer complements miniature current recorders, mounts in 6"x 6" cutout.

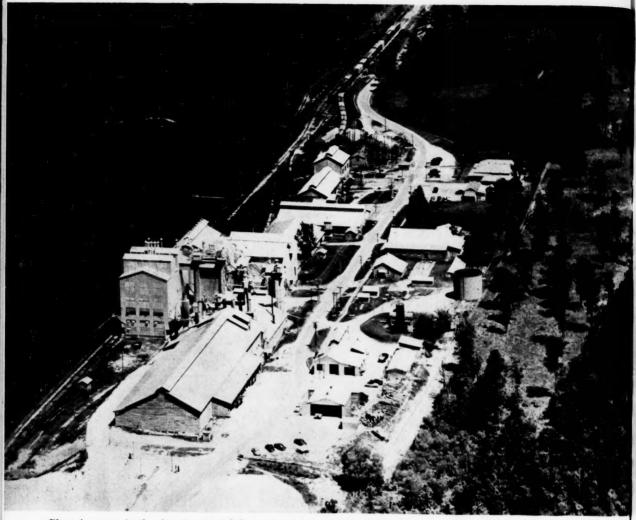
ACCESSORIES FOR YOUR REQUIREMENTS. Variety of flow chambers and immersion and submersion units adapt Model J System to your present and future plant applications.

Beckman

INSTRUMENTS, INC.

SCIENTIFIC AND PROCESS INSTRUMENTS DIVISION

Fullerton, Calif.



Plant is conveniently close to attapulgite strip-mining operations that take place in both Florida and Georgia.

Attapulgite: 1 Process, 90+ Grades

This Minerals & Chemicals Philipp Corp. facility in Georgia receives clay from nearby strip-mining, then processes it to satisfy a host of varied end-uses.

N. P. CHOPEY
Assistant Editor

Tucked away in Georgia's southwest corner, a highly flexible plant of Minerals & Chemicals Philipp Corp., Menlo Park, N. J., processes attapulgite into over 90 commercial grades. der

the

fini

giv

exi

clay

the

Atta

Chemically, attapulgite is hydrated magnesium aluminum silicate. It consists of narrow, needleshaped crystals that take on a fiberlike pattern when dispersed in liquids. Among the properties that give the material its usefulness are its chemical inertness, great sorptivity for a variety of fluids, and good capacity to thicken liquids.

Located at Attapulgus, Ga., the plant yields

grades with a host of uses: purifying agents for petroleum refining; carriers and diluents for insecticides, herbicides and other agricultural chemicals; additives for drilling-muds; floor absorbents for oils and greases; ingredients for pharmaceuticals and cosmetics; and other applications.

Plant capacity is hard to pin down because it depends greatly on the particular grades being made, but the facility is said to be the largest in the world for processing attapulgite.

▶ Handling Clay—Although the plant is in Georgia, most of its raw-material clay is strip-mined in nearby Gadsden County in Florida. Since the clay varies in its properties, mine samples are analyzed—the company processes the samples, then actually tries out their suitability for the finished products' various end uses, in bench-scale equipment.

After it has been sampled, trucks bring a given batch from the mines to the plant, where it is stored in a roofed shed. (A 7-10-day feed supply of the raw material is maintained in storage.)

At this point, the clay exists as fairly hard, friable lumps with a waxy surface and olive-grey color. It contains 50% volatile matter, mostly free or combined water.

In the shed, the batches are stored segregated as to their end use. Most of the plant equipment exists in parallel lines, so that more than one grade can be processed at once.

As a first step, conveyor belts transport the clay to hammer mills (equipped with moving breaker plates to minimize clogging) that reduce the material to granules of ½-in. size or smaller.

► Extruded, Unextruded—The plant makes both extruded and unextruded grades, each type having its own specific applications.

To make extruded grades, clay goes from the hammer mill to roll crushers, which yield 1-in. flakes about ½ in. thick. These enter pug mills and are combined with enough water to make a plastic mass suitable for extrusion.

Pug-mill product is ready for the extrusion step, which breaks down individual bundles of crystals within the clay and thus exposes more of the needles. Company uses three screw-type extruders with multiple-orifice die plates.

Product rods leaving the extruders are 0.4 to 0.75 in. in dia., and the rods are allowed to break up during the handling steps that follow.

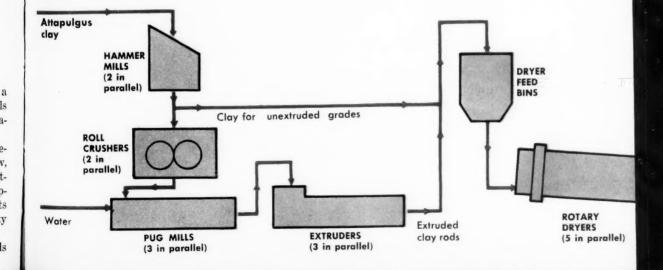
Next step is to dry the material. The plant has five countercurrent rotary dryers: the smallest is 6 ft. in dia. by 60 ft. long, and the largest is 10 ft. by 65 ft. These can be fired by gas or oil, and operate at 300-1,200 F. depending on the grade being produced.

As for unextruded grades, they go directly from the hammer mill to the dryer feed bins, and are dried over the same temperature range.

► Fine Grades—Remainder of the process consists of size reduction and classification. Plant output can be divided into granular products (coarser than 100 mesh) and fine products.

To make fine grades, material from dryerproduct storage bins goes to roller-pulverizers. There are five of these, with rolls varying from 40 in, to 60 in, in dia.

For grades of 325 mesh or coarser, output



ded—The plant makes both uded grades, each type havapplications.

ded grades, clay goes from oll crushers, which yield 1-in. hick. These enter pug mills th enough water to make a for extrusion.

t is ready for the extrusion down individual bundles of ay and thus exposes more of y uses three screw-type ex--orifice die plates.

aving the extruders are 0.4 the rods are allowed to break ing steps that follow.

dry the material. The plant nt rotary dryers: the small-These can be fired by gas or 300-1,200 F. depending on uced.

led grades, they go directly ll to the dryer feed bins, and ame temperature range.

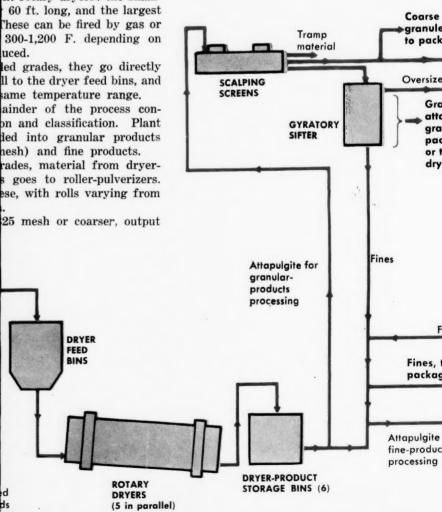
on and classification. Plant ded into granular products nesh) and fine products. rades, material from dryer-

s goes to roller-pulverizers. ese, with rolls varying from

is routed directly to product bins. For fi grades, the roller-pulverized material is furt reduced to yield a powder, 60-95% of which finer than 10 microns.

► Granular Grades—Material for granular sa is routed from the dryer-product bins to a brating, double-deck screen. The top screen moves tramp material. Intermediate product fr the second screen is ground, and fine mate from the bottom of the screen goes directly t sifter for classification.

Oversize from this sifter combines with intermediate cut from the vibrating screen, a the mixture enters a mill bin. From there, passes through a corrugated-roll crusher hav four corrugations per inch.



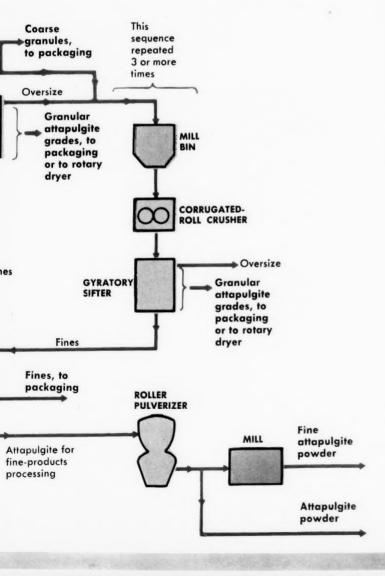
ns. For finer rial is further % of which is

granular sales bins to a vitop screen ree product from fine material s directly to a

oines with the ag screen, and from there, it rusher having Crusher product enters a second gyratory sifter that also separates granular grades. Oversize is sent to further crushing, and the crushing-sifting sequence is repeated several times as required.

Company uses this multiple system for the granular grades in order to keep fines production as low as possible. Whatever fines do emerge from the sifters are either marketed directly or routed to production of powders.

Typical granular grades for marketing are 15/30, 30/60 and 60/90 mesh. In some cases, the granular products are not marketed directly but are sent to the rotary dryers for calcining. Calcined product is cooled by air and is ready for marketing without additional classification.





MIX-MULLER®

Controlled Dispersion for effective process control

If you mix dry solids, how long has it been since you gave serious thought to the action employed by your mixer?

If you're mixing dissimilar and/or disproportionate materials; coating a fine dry material; blending liquids into powder or dispersing a small amount of liquid or binder—you need *more* than a simple stirring, tumbling or agitator action can *give*.



Look at it this way...today's raw materials are more uniform, of higher purity and they cost more. Quality control standards are stringent. It's easy to get caught in the bind between soaring materials costs, tougher control standards and high waste. Oddly enough, processors who spare no expense in otherwise equipping a process with the most modern time-saving components often overlook a principal source of waste...outdated mixing practices.

We would like to demonstrate

how you can save valuable raw materials and inmany cases eliminate secondary processing by making the most of mixing properties—with a Simpson Mix-Muller. Write for details on a confidential, laboratory conducted mulling survey and for our Handbook on Mulling.



P-361W

SIMPSON MIX-MULLER DIVISION NATIONAL ENGINEERING COMPANY

636 Machinery Hall Bldg., Chicago 6, Illinois

acids

If you use any of these chemicals, PYREX* Pipe solves your corrosion problems completely



Any chemist can tell you why even the most active of acids slide through PYREX Pipe without biting.

This heavy-duty borosilicate glass just will not react with any chemical except hydrofluoric acid and several of the hot concentrated alkalies.

Any accountant could give you another good reason for using PYREX Pipe... it actually costs less than many other materials when all installation costs are considered—much less when you include maintenance. If this seems an extreme statement, one of our salesmen can give you specific figures on your plant piping.

You can see through it. You can see inside this pipe, spot trouble immediately, locate it exactly.

You can work hot with it. Run chemicals up to 450° F., even with thermal shocks as high

as 200° F. without buckling or breakage.

It's tough, easy to install. Your own plant men can install PYREX Pipe, usually much faster than metal pipe, because it's lightweight, takes only half as many hangers. A Car tough of con quality gives f alloy s abrasio bridge resists

rides,

strengt

There

special

See ou

Снеміс

Heat exchangers and drainlines, too. We also make a complete line of PYREX brand heat exchangers and laboratory drainlines and fittings.

See our insert in the 1960 Chemical Engineering Catalog. For complete information, write to the address below for bulletins, or contact your Corning salesman.

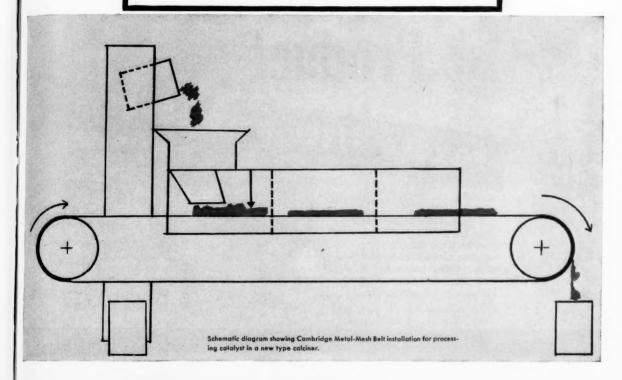


CORNING GLASS WORKS

8912 Crystal St., Corning, N. Y.
CORNING MEANS RESEARCH IN GLASS

December 25, 1961—CHEMICAL ENGINEERING

Cambridge Type 316 Stainless Metal-Mesh Belt



BEATS CORROSION PROBLEMS TO MAKE CONTINUOUS CHEMICAL PROCESSING MORE PROFITABLE

A Cambridge Belt works two ways to beat the tough operating problems that are usually a part of continuous chemical processing. First, careful, quality workmanship means a belt that lasts longer, gives fewer maintenance problems. Second, proper alloy selection can lick problems like corrosion or abrasion. Take corrosion for instance. The Cambridge Type 316 Stainless Steel Metal-Mesh Belt resists such corrosives as acetic acid vapors, chlorides, bromides and iodides. And, it has extra strength at high temperatures.

There is a complete line of Cambridge Belts in special and standard metals and alloys to meet your

specific requirements—custom-built in any weave to insure the most efficient processing.

Experienced Cambridge Field Engineers—experts in their field—are available to discuss your needs and help you select the belt best suited to your operations. Or, they can offer you sound advice on the installation, operation and maintenance of your

Cambridge Belts. Talk to your Cambridge man soon. He's listed in the Yellow Pages under "Belting, Mechanical". Or, write for free 130-page reference manual.



See our data sheets in Chemical Engineering Catalog, pages 1160, 1161 for technical information and representatives.



The Cambridge Wire Cloth Co.

DEPARTMENT G • CAMBRIDGE 12, MD.

Manufacturers of Metal-Mesh Conveyor Belts, Flat Wire Conveyor Belts,
Wire Cloth, Wire Cloth Fabrications, Gripper® Metal-Mesh Slings





THREADED

FORGED STEEL WELD COUPLETS

The Vogt Weld Couplet is an easy-to-install fitting for branch connections from pipe, vessels or tanks. It replaces more-difficult-to-install welding bosses, couplings and the type of fittings requiring trimming or matching to fit contour of vessel or pipe.

Exclusive Voot "WELD RING"



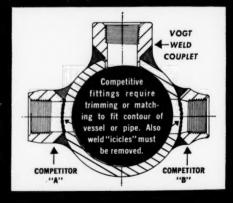
Small Diameter Pipe



Large Diameter Vessel

Vogt Weld Couplets adapt to any pipe or vessel curvature by simply adjusting the height position of the couplet when welding. This characteristic means easy installation, positive positioning and alignment, a stronger weld without distortion, and no inside "icicles" of welding

Couplets are available in carbon steel, conforming to A.S.T.M. specifi-cations. Other materials can be supplied on special order.



Write for Folder SWC-1 to Dept. 24A-FC.

VALVES, FITTINGS FLANGES & UNIONS See our complete

For Direct Long Distance

to Louisville dial: 502 ME 4-9411 HENRY VOGT MACHINE CO., P. O. Box 1918, Louisville 1, Kentucky

SALES OFFICES: Camden, N. J., Charleston, W. Va., Chicago, Cleveland. Dallas, Los Angeles, New Orleans, New York, San Francisco, Seattle, St. Louis



inclu natui accur that classi Elect

It wa

tion

rapid

histo

ning In tion

Ho ated o time energ techn as m spuri

Ra izing only non-i the v chem trvphysi pound

> effect radia

Natu

It itiate secon a res the in Sec and,

CHEN

line in Catalog F-10

Radiation Chemistry Practical?

Yes, radiation-induced reactions are practical for certain processes. Here are useful data on reactions, radiation sources, relative costs to help you develop an intelligent answer to this question.

PAUL Y. FENG, Armour Research Foundation

It was only during and after World War II that radiation chemistry and other nuclear sciences enjoyed rapid development. This, despite the fact that the history of radiation chemistry goes back to the beginning of the century.

In the past, the chemical effects of ionizing radiation played key roles in nuclear-science development, including the discovery of X rays by Roentgen and of natural radioactivity by Becquerel. By the 1920's, accumulation of knowledge in this field reached a stage that enabled Lind to prepare the radiation-chemistry classic "The Chemical Effects of Alpha Particles and Electrons."

However, the pace of developments greatly accelerated during the 1940's. This was partly due to the wartime need for information on the effects of highenergy radiations on various chemical systems. Also, technological developments in "unrelated" fields such as microwave technology and computer design also spurred experimental and semi-theoretical studies.

Radiation chemistry, which covers the effect of ionizing radiation in matter, differs from photochemistry only in degree—photochemistry usually deals with the non-ionizing events caused by low-energy photons in the visible and near ultraviolet region. Also, radiation chemistry is distinct from radio (or nuclear) chemistry—a subject involving the chemistry (and possibly physics) of various isotopic elements and their compounds. Radiochemistry is not concerned with the effects of radiations emitted by elements or analogous radiations produced by other methods.

Nature of Radiation-Induced Reactions

It is generally agreed that chemical reactions initiated by ionizing radiations are largely caused by secondary electrons. These electrons are produced as a result of the interaction of primary radiations with the irradiated media.

Secondary electrons possess a wide range of energy and, in turn, undergo further interaction processes

with environmental molecules. These various interactions produce ionized and excited species (as well as additional secondary electrons). Such species are, generally, extremely reactive, and can initiate a large variety of reactions that occur with different probabilities in the irradiated systems.

Schematically, some of the more important reactions can be written as shown in Table I, p. 68.

In addition to starting materials, all of the intermediate products formed as shown, and other reaction steps, could again undergo similar processes. Thus, a large number of final products (and hence reaction steps) can usually be identified in a given radiation-chemical reaction.

One primary goal of radiation chemists is to determine the relative probabilities and rates of these various processes, and to understand the factors that influence the magnitude of these effects.

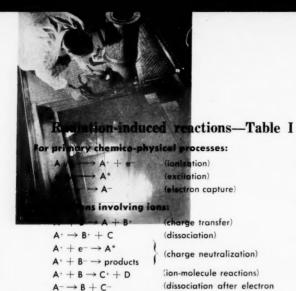
Important Factors That Affect Reactions

There are a number of factors—such as chemical structure, composition, temperature, and the nature of the ionizing radiation used—that usually affect the outcome of a radiation-chemical reaction. These various factors are considered briefly below.

Chemical Structure—The radiation behavior of a compound, as would be expected, depends on its chemical structure

In general, radiation stability of a specific chemical bond increases with increasing bond strength, whereas radiation behavior of approximately equivalent bonds can often be predicted quite well on a statistical basis. Thus, for example, weakly bonded groups such as iodine are particularly sensitive to radiation.

The conjugated structure of an aromatic compound, however, imparts considerable stability to the nuclear portion of a molecule. Similarly, when such strong chemical effects are absent, as with hydrocarbons, the relative amounts of radiolytically produced methane and hydrogen gas can be readily explained on the basis



For reactions involving excited species:

 $\begin{array}{lll} \mathbf{A}^* + \mathbf{B} \rightarrow \mathbf{A} + \mathbf{B}^* & \text{(energy transfer)} \\ \mathbf{A}^* \rightarrow \mathbf{B}^* + \mathbf{C}^* & \text{(radical formation)} \\ \mathbf{A}^* \rightarrow \mathbf{B} + \mathbf{C} & \text{(molecular reaction)} \\ \mathbf{A}^* \rightarrow \mathbf{B} & \text{(rearrangement)} \end{array}$

capture)

For reactions involving radicals:

 $\begin{array}{lll} R_1 \bullet + R_2 \bullet \to R_1 R_2 & (combination) \\ R \bullet + DH \to RH + D \bullet & (abstraction) \\ R \bullet + C \to RC \bullet & (addition) \\ R_1 \bullet + R_2 \bullet \to C + D & (disproportionation) \\ R_1 \bullet \to R_2 \bullet + D & (dissociation) \end{array}$

of the relative numbers of methyl and hydrogen groups in the parent molecule.

Composition—Because of the possibility of various energy- and charge-transfer processes and of reactions of intermediates with environmental molecules, a radiation-chemical reaction is quite sensitive to composition of the irradiated system.

Consider an ordinary thermal reaction. It is conceivable that under certain conditions only one of the reactants will be predominantly activated to form a specific activation complex, regardless of the relative amounts of reactants. However, in a radiation-induced reaction, a change of the relative amounts of components may result in a change in the relative amounts of the various reactive intermediates.

Also, free-radical and ion-molecule processes are very important in radiation-chemical reactions. Thus, sensitivity of these processes toward minute amounts of many chemical species, even the presence of small amounts of foreign materials, may substantially alter the course of a radiation-induced reaction. This is well-illustrated by the radiolytic behavior of water. Pure water is barely decomposed by gamma rays or energetic beta rays if oxygen has been carefully removed from the irradiated system; but water can be decomposed easily if it contains dissolved oxygen.

Temperature—Effects of temperature on conventional and radiation-chemical reactions are inherently different. In conventional chemical processes, thermal

energy is responsible for formation of activated intermediates and for their reactions. In radiation-chemical reactions, reactive intermediates are formed by interaction of primary radiations and secondary electrons with irradiated media. Temperature changes would, therefore, not affect the formation of these intermediates, but would influence the rates of reactions of these intermediates with other reactants. Consequently, radiation-chemical reactions can occur at extremely low temperatures, where the outcome often differs substantially from those reactions observed at higher temperatures.

Nature and Intensity of Ionizing Radiation—Reactive intermediates produced in an irradiated system can react with each other as well as with environmental molecules. The outcome of a given radiation-induced reaction will, therefore, be directly dependent on the concentration of these intermediates. And intermediate concentration is directly dependent on the nature and to a lesser extent on the intensity of the ionizing radiation used to initiate the reaction process,

If a heavily ionizing radiation is used (which loses energy rapidly in matter) such as alpha particles, the instantaneous concentration of reactive intermediates along the paths of incoming radiation is necessarily high, favoring their interaction with each other. If low specific ionization radiation is used (which loses energy sparingly in matter) such as gamma rays, reactions of intermediates with environmental molecules will be more probable, since the concentration of these intermediates in the system will be low.

Thus, for example, when pure deoxygenated water is irradiated by heavily ionizing radiations such as fission fragments, alpha particles, deuterons or protons, the hydrogen and hydroxyl radicals tend to react with each other. This leads to formation of molecular hydrogen, hydrogen peroxide and, hence, molecular oxygen. The irradiation of deoxygenated water by sparsely ionizing radiations such as gamma rays or energetic electrons, however, results in very small amounts of decomposition, unless sources of extremely high intensity are used.

Units in Radiation Chemistry

Radiation chemistry involves the conversion of one chemical substance into some other species as a result of absorption of radiation energy. Consequently, radiation-chemical units are necessary to provide quantitative measures of the extent of radiation energy absorbed, as well as the extent of chemical reaction.

The unit for the amount of energy absorbed, or the radiation dose, is the rad. This is defined as the absorption of 100 ergs of radiation energy per gram of irradiated material. A dose of 10° rads, or one megarad, is equivalent to about 2.4 cal./g.

Another absolute unit, the electron-volt (ev.)* per gram, is also used in the literature. (Some other units that have been used prior to general acceptance of the absolute units include the roentgen, the roentgen-

equive fined is app for the 1 rep. Un

units

press

Not can be ceived tion i radiat tain rabsor from of exfield of this control of

The reacti of mo 100 e molec value 1,150

Many

Any the ve large In pra usuall simple accele

Isotop

Dur isotop used ochemic venier they we machi advent become labora

At power actors the be uct in

isotop

Am a half But co less e

Снем

^{*}One electron-volt, or the energy required to move an electron over a field gradient of one volt, is equal to 1.6 x 10^{-19} erg.

equivalent-physical (rep.) and the rather poorly defined pile-unit. Without going into details, 1 roentgen is approximately 0.83 rad, while the conversion factor for the rep. varies with the system irradiated, about 1 rep. = 0.93 rad for aqueous systems.)

Units for the intensity of radiation fields depend on units for radiation dose. Thus, dose rates are expressed in terms of dose per unit time, e.g., rads/hr.

Note that, although the intensity of a radiation field can be a well-defined parameter, the radiation dose received by a sample is usually not the product of radiation intensity and exposure time of the sample. First, radiation intensity is given with reference to a certain material (such as air or water) whose radiation-absorption characteristics might differ significantly from the actual irradiated sample. Also, the presence of excessive heterogeneous interfaces in a radiation field can disturb the secondary electron equilibrium. This effect may be so large that the absorbed dose has little relationship with field intensity.

The unit for yield of a radiation-induced chemical reaction is the *G*-value. This is defined as the number of molecules, ions or radicals formed or destroyed per 100 ev. of absorbed radiation energy. Since 1 ev./molecule is equivalent to 23 kilocalories/mole, a *G*-value of 4 is equivalent to an energy requirement of 1,150 kilocalories/mole of product.

Many Radiation Sources

er-

cal

er-

ns

ld,

li-

se

ly,

ly

b-

n-

c-

m

ie

es

s,

3-

r.

s,

9-

Any ionizing radiation, including cosmic rays and the very high energy particles produced by modern large accelerators, can be used in radiation research. In practice, however, studies in radiation chemistry are usually carried out with isotopic sources or relatively simple but extremely efficient devices such as electron accelerators or X-ray machines.

Isotopic Materials Are Popular

During the earliest stages of radiation research, isotopic sources, such as radium salts or radon, were used extensively to study the effect of radiation on chemical systems. Because of high cost and inconvenience often associated with the use of such sources, they were unable to compete with devices such as X-ray machines in the early years. However, with the recent advent of nuclear reactors, radioactive isotopes have become increasingly available. A growing number of laboratories are equipped with one or more powerful isotopic sources in their research and development centers.

At present, the most important isotope sources are: cobalt-60, which is now produced at low cost in certain power reactors; spent fuel elements from nuclear reactors; and cesium-137 (as well as, to a smaller extent, the beta-emitting strontium-90) obtained as a byproduct in the reprocessing of reactor fuels.

Among the three gamma sources, cesium-137, with a half-life of some 30 yr., has the longest useful life. But cesium-137 emits a radiation that is considerably less energetic than shorter-lived cobalt-60 radiation (half-life = 5 yr.). Fuel elements, on the other hand, decay at a much greater rate. And they also have the added disadvantage that such sources invariably have neutron levels much higher than those of cobalt-60 or cesium-137 of comparable strength.

Consequently, for practical applications, cobalt-60 appears to be somewhat preferable (available in large quantities at a reasonable cost, necessary penetrating power, adequate half-life, and capable of producing a reasonably intense radiation field). It is, therefore, probably for these reasons that more than 20 firms and institutions in the United States have cobalt-60 sources above or at the 10,000 curie level. Megacurie facilities both in Australia and in the U.S. will also be using this isotope as a source of gamma rays.

How Useful Are Machine Sources?

During 1920-1940, machine sources played a significant role in the development of radiation research. Since World War II, machine electron accelerators have become practical and quite reliable radiation sources. They are capable of producing a large amount of radiation energy with relatively low capital investment.

Now, at least three types of electron accelerators have demonstrated their potential values as energy sources for applied radiation technology. These include the Van de Graaff machine, the resonant transformer, and the linear accelerator. In addition, a number of other electrostatic accelerators for the production of mev. electrons are also at various stages of development. All of these machines are capable of providing radiation energy at the kilowatt or greater range—a figure that compares favorably with the 15 kw. output of a cobalt-60 source of exactly 1-million curies.

In addition to electron accelerators, other machines such as cyclotrons have also been used in fundamental radiation chemical research. It is unlikely, however, that these machines would be useful in industrial applications.

Chemonuclear Reactors: Another Way

A chemonuclear reactor is a nuclear reactor designed specifically for chemical applications. As such, it could be either designed to provide heat energy needed for chemical processes (a process heat reactor) or radiation energy.

A large part of the power of such a reactor initially is in the form of kinetic energy of the fission fragments. Thus, a chemonuclear reactor is a low-cost source of megawatt radiation.

Despite such a promise, however, chemonuclear reactors are not without serious difficulties.

The fission fragments are extremely radioactive, and must be efficiently removed by remote control processes from the radiation chemical products. Also, control of a reactor with constantly changing component compositions can be extremely difficult. And, there is a paucity of fundamental knowledge concerning the

radiation chemistry of such very highly ionizing fistion energy.

Radiation Dosimetry

From the viewpoint of either fundamental research or practical application, radiation dosimetry constitutes an important phase of any radiation chemical process.

Analysis of the mechanisms of a radiation chemical reaction often requires a precise knowledge of the yield of the various products, and hence accurate information of the radiation energy absorbed by the sample. In practical applications, ability to continuously monitor radiation doses received by processed items would directly affect product quality, as well as cost of the complete process. (It must be emphasized here that radiation energy is an expensive form of energy when compared to either thermal or electric types.)

For laboratory purposes, the universally accepted dosimetry standard is now the ferrous sulfate, or Fricke dosimeter. This is a dilute solution of ferrous sulfate (or ferrous ammonium sulfate) in aerated 0.8N sulfuric acid. Irradiation of this solution results in conversion of ferrous ions into ferric ions as follows:

$$H_2O \longrightarrow H \cdot + OH \cdot$$
 $OH \cdot + Fe^{++} \longrightarrow OH^- + Fe^{+++}$
 $H \cdot + O_2 \longrightarrow HO_2 \cdot$
 $HO_2 \cdot + Fe^{++} \longrightarrow Fe^{+++} + HO_2 \xrightarrow{H^+} H_2O_2$
 $H_2O_2 + 2Fe^{++} \longrightarrow 2Fe^{+++} + 2OH^-$

Thus, for each molecule of water decomposed, four ferrous ions will be converted to ferric. The $G(Fe^{+++})$ value for this reaction is 15.6. Within limits, this G value is independent of dose rate and temperature. It is, however, limited to relatively low total doses—a considerably lower G value would be effective when dissolved oxygen is exhausted.

In addition to the ferrous sulfate dosimeter, a number of other dosimetry systems also have specific applications. These include, among others, the ceric-sulfate dosimeter (useful for high doses): the cobalt-glass dosimeter (relative convenience); various organic-dye dosimeters; a dosimetry system based on the gelling of polymers (useful as a go-no-go dosimeter); a dosimetry based on the decomposition of polymers (wide range); and various dosimetry systems based on the property changes of organic substances.

All such dosimetry systems, as well as those based on physical principles, have the same difficulty—their radiation absorption characteristics may not be similar to the actual irradiated system. Consequently, a correction factor must be applied to the readings of the dosimeter measurements. These factors are based either on the electron densities of the dosimetry and the experimental systems, or better, on known absorption characteristics.

Consider Some Radiation Chemical Reactions

These various dosimetry schemes are good examples of radiation chemistry at work. Let us consider a few such reactions to illustrate various radiation effects.

Aqueous Systems—The ferrous sulfate dosimetry system is an example of the radiation chemistry of aqueous systems. Other important aqueous systems include: pure water, various solutions, and biological systems.

In general, the radiation chemistry of aqueous systems is characterized by reaction processes by indirect action. Almost invariably, the reaction mechanism involves initial decomposition of water molecules with subsequent interaction of hydrogen and/or hydroxyl radicals with the solute species. These radicals can also interact with each other instead of with the solutes. Mathematical treatment of the diffusion kinetics of aqueous systems has constituted, for several decades, one of the most active areas in the semi-theoretical aspects of radiation chemistry.

Organic Systems—In organic systems various covalent bonds can be broken with relative ease using radiation. The fragments can then react. Furthermore, depending on experimental conditions, radiolysis of organic compounds can proceed via any one or all of the reaction mechanims (radical, molecular, or ion-molecule).

Thus, for example, formation of hydrogen gas during the radiolysis of a liquid hydrocarbon could be either radical or molecular as shown in the following reactions:

Radical reaction:

$$C_6H_{14} \longrightarrow C_6H_{13} \cdot + H \cdot$$

 $H \cdot + C_6H_{14} \longrightarrow C_6H_{13} \cdot + H_2$
Molecular reaction:
 $C_6H_{14} \longrightarrow C_6H_{12} + H_2$

Both processes probably exist: addition of iodine to hexane will suppress a portion, but only a portion, of the hydrogen yield. Since iodine is considered to be a reasonably efficient radical scavenger, the decrease in $G(\mathbf{H}_2)$ in the presence of iodine is often considered to indicate the extent of the radical process. Extent of \mathbf{H}_2 formation in the presence of iodine (or other radical scavengers) is taken as an indication of the molecular reaction.

If, instead of liquid hydrocarbon, a gaseous compound such as methane is irradiated, the hydrogen gas may also come from an ion-molecule process as follows:

$$\begin{array}{ccc} CH_4 & & & & CH_3^+ + H + e^- \\ CH_3^+ + CH_4 & & & & & C_2H_5^+ + H_2 \end{array}$$

Obviously, other possible reactions, such as those involving the hexyl radical, would also take place.

These molecul parent

Practic

Radi interes food st essing process

polyme

Bact

known food be years Since United Union, of food consider It n

is both off-flav of some ization It sh

It shout had longer produce in com-

tion is a numi cluding as disp

CHEM

Irradia Molecular rradiation cos

f

ıl

Energy requirements and irradiation costs—Table II

		G Values †						
		1	5	10	100	10,000		
	kwh./lb.	24	4.8	2.4	0.24	0.024		
Lindiation o	\$*	60	12	6	0.60	0.06		
lection weigh	o							
Energy read	kwh./lb.	12	2.4	1.2	0.12	0.012		
Irradiation o	S*	30	6	3	0.30	0.03		
lecular wald	a 400							
Energy recy	kwh./lb.	2.4	0.48	0.24	0.024	0.0024		
Irradiation co	osts, \$*	6	1.2	0.60	0.06	0.006		
lecular weigl	ht 1,000							
Energy required, kwh./lb.		1.2	0.24	0.12	0.012	0.0012		
Irradiation co	osts, \$*	3	0.60	0.30	0.03	0.003		
lecular weigh	nt 10,000							
Energy required, kwh./lb.		0.12	0.024	0.012	0.0012	0.00012		
Irradiation co	osts, \$*	0.30	0.06	0.03	0.003	0.0003		

Based on \$2.50/kwh. † G-Value is defined on p. 69.

These lead to formation of various products having molecular weights both greater, and smaller, than the parent hydrocarbon.

Practical Radiation Chemical Systems

Molecular weight Energy require

Molecular weight

Radiation chemical systems of possible practical interest can be divided into three general groups: food sterilization and pasteurization; radiation processing of simple organic compounds; and radiation processes involving a number of natural or synthetic polymers.

Sterilizing Food

Bactericidal effects of ionizing radiations have been known for many years. But radiation sterilization of food became a practical possibility only during recent years when large radiation sources were developed. Since 1950, a number of countries, including the United States, the United Kingdom, and the Soviet Union, have been studying the radiation sterilization of food. This is a popular topic and has received a considerable amount of publicity.

It now appears that, while radiation sterilization is both feasible and safe, there is still the problem of off-flavor and, to a certain extent, cost. A total dose of some 4 megarads is needed to assure adequate sterilization.

It should be noted that radiation pasteurization does not have these difficulties. And the demonstrated longer shelf-life of many radiation-pasteurized food products attests to the potentialities of this process in commercial ventures.

In addition to food sterilization, high-energy radiation is also used commercially for the sterilization of a number of medical and pharmaceutical products, including yeast, ointments, and medical supplies such as disposable syringes.

Radiation of Simple Organic Compounds

Potentially interesting organic systems must involve either large price differentials or high yields.

This is because of the relatively high cost of radiation energy and usually low G values (~ 3) for many simple organic reactions. Some of the systems which may fulfill such requirements are listed below.

Phenol From Benzene and Water-Here is a system that has received considerable attention because of price differentials and potential volume. Probably, the G value for phenol formation could be increased substantially with increased temperature and oxygen pressure.

Hydrazine From Ammonia-In an analogy to the phenol system, preparation of hydrazine from ammonia, if successful, would also constitute a particularly favorable process. At present, this process still appears to be feasible, on the basis of electric-discharge experiments.

Ethylene Glycol From Methanol-Both the price differential (factor of about 3) and the potential volume (possibly exceeding 1-billion lb./yr. in a few years) makes this synthesis an attractive process. At present, the G value for the conversion reaction is in the order of 2-3.

Preparation of Fluorinated Compounds-Organic fluorine compounds often have unique chemical and physiological properties, but are usually somewhat difficult to synthesize. Radiation chemical methods permit introduction of fluorine or fluorine-containing groups to complicated molecules under mild and controlled conditions and are of potential interest. The G value for some of the reactions studied are of the

Preparation of Alkane Sulfonyl Chlorides-Many hydrocarbons, when irradiated in the presence of sulfur dioxide and chlorine, could incorporate the SO₂Cl group in very high yields. In addition, the disulfochlorinated product, which may be useful as intermediates for the preparation of polymers, is also formed in good yield.

Radiation Processing of Polymers

Use of ionizing radiation to process polymers or polymerizable materials still constitutes one of the most promising areas of applied radiation. This is due to the very high molecular weights involved and the possibilities for chain reactions.

Cross-Linking of Polymers-Among the better known processes are: preparation of heat resistant polyethylene for various domestic and industrial applications; the L-film of W. R. Grace & Co.; and treatment of silicone products.

Graft-Copolymerization Reactions-Some of the examples in this area include the ion-exchange membranes produced by American Machine and Foundry and the Raibond of Radiation Applications. At present, application of the radiation-induced graft copolymerization process to the treatment of textiles seems to have considerable promise. A number of laboratories, both in the U.S. and abroad, are engaged in research and development work in this area.

Polymerization of Monomers-Radiation processes could, in principle, be used to prepare many polymeric substances from the corresponding monomers. But such processes must compete both in economy and in product quality with other highly developed methods in the polymer industry. Consequently, with the exception of some limited Japanese efforts in low-temperature polymerization reactions, there is not enough incentive for industrial organizations to prepare commercial products by irradiating monomeric material directly. Nevertheless, much work in this area is still going on in many laboratories, with current emphasis on polymerization at low temperatures. Results of such studies usually indicate that the reactions have a pronounced ionic character, and that the polymers obtained often have higher degrees of crystallinity than those obtained at higher temperatures.

Economics of Applied Radiation Chemistry

As an illustration, the cost of radiation energy in kwh, units will be calculated using the following assumptions for a 1-million curie cobalt-60 source: (1) initial cost of the facility is \$1 million, (2) the expected return on investment is 6%, and (3) the operating cost, depreciation, and source decay amount to 20% during the first year.

Average energy output of the source during the first year is 14.1 kw. (being 14.8 kw. initially), the average cost of radiation energy is then \$2.1/kwh. Assuming further that 80% of this energy can be used productively, the cost becomes finally \$2.5/kwh. of absorbed radiation energy.

Irradiation Costs of Selected Processes

Food Sterilization and Pasteurization-Assume that

 4.5×10^{6} rads will be needed for food sterilization and 2.0 × 105 rads for pasteurization. Energy required per pound of food will amount to 5.6 watt-hr. for sterilization and 0.26 watt-hr. for pasteurization. At \$2,5/ kwh., the irradiation costs per pound of food are then 1.4¢ and 0.065¢ respectively.

Chemical Synthesis-Assume that a compound (molecular weight = 100) can be synthesized with G = 5, the total energy required per pound of product is then $(100/5) \times 1.6 \times 10^{-12} \times 6.02 \times 10^{23} \times (450/$ $100) = 8.69 \times 10^{11} \text{ ergs or } 2.4 \text{ kwh. At } 2.5/\text{kwh.}$ the irradiation cost is then \$6/lb. Similar calculations for other molecular weights and G-values have also been made. These are given in Table II on p. 71.

References

1. Swallow, A. J., "Radiation Chemistry of Organic Compounds," Pergamon, 1960.
2. Haissinsky, M., (Ed.), "The Chemical and Biological Action of Radiations," Academic Press, 1960-1.
3. "Proceedings of the First International Congress of Radiation Research" (Radiation Research, Supplement No. 1), Academic Press, 1959.
4. "Proceedings of the First International Conference on Peaceful Uses of Atomic Energy," Vol. 7, United Nations, 1956.
5. "Large Radiation Sources in Industry," Vol. 1, 2, International Atomic Energy Agency, Vienna, Austria, 1960.
6. Nucleonics, special Issue on radiation chemistry, Vol. 19, No. 19 (1961).
7. Scientific American, special issue on radiation chemistry, Sept. 1959.

1. Scientific American, special issues on radiation chemistry, Vol. 36, No. 6, 7 (1960).
9. "Proceedings of the Second International Conference on Peaceful Uses of Atomic Energy," Vol. 29, United Nations, 1958.
10. Annual Review of Physical Chemistry and Annual Review of Nuclear Science, Annual Reviews, Inc., Palo Alto, Calif.

Meet the Author



PAUL Y. FENG, is supervisor of chemical physics research at the Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill. He received his B.S. in 1947 from the Catholic Univ. in Peiping, China. Coming to the U.S. in 1950, he studied at Washington University of St. Louis, and received his Ph.D. in 1954. Dr. Feng was connected with the American Testing Laboratories, in 1954-55, then joined ARF. His experience is in the fields of nuclear and radiation chemistry. He served on various occasions as lecturer on nuclear chemistry, radiation chemistry, and nuclear physics at the graduate school of I.I.T., as a visiting professor at the Institute of Nuclear Science in Formosa, as a technical advisor on the U.S. delegation to the 2nd International Conference on the Peaceful Uses of Atomic Energy at Geneva in 1958, and a member of the U.S. delegation to the International Atomic Energy Agency Tritium Symposium in Vienna in 1961. He has published a number of papers, is a member of ACS, Amer. Phys. Soc., Amer. Nucl. Soc., Radiation Res. Soc., and Sigma Xi.

insolub are at either o capable matrix polysty as celli materia polyme diagran treatme fonated In g mers a ing a in

Ion-e

ing it desired ing or monom the de nomic more p proced at rig styren rectly. The

is wel comme cross-l tion-ex fonic carbox anionweak-

CHEMI

resins



Using Ion-Exchange Resins and Membranes

This separation technique is finding favor in chemical processing. Its theory and practice are examined.

HARRY P. GREGOR, Polytechnic Institute of Brooklyn

Ion-exchange resins are simply insoluble organic matrices to which are attached specific groupings either of ionic character or that are capable of ionic reactions. This base matrix material can be cross-linked polystyrene, a natural product such as cellulose or, where more stable materials are desired, a fluorinated polymer. The figure at right shows diagrammatically a typical water-treatment resin—in this case, sulfonated polystyrene.

and uired teril-\$2.5/ then ound with duct

450/ wh.,

also

tion

on 956. ter-

19

try,

em-

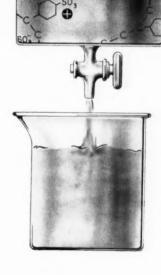
In general, ion-exchange polymers are prepared either by forming a insoluble resin and then treating it chemically to attach the desired grouping, or by polymerizing or copolymerizing a mixture of monomers, one of which contains the desired group. From an economic point of view, it is usually more practical to employ the former procedure, as is the case illustrated at right where cross-linked polystyrene beads are sulfonated directly.

The technology of ion-exchange resins of the water-treatment type is well-established. Almost all the commercial resins are based upon cross-linked polystyrene, with cation-exchange materials of the sulfonic acid, phosphoric acid and carboxylic acid types, and with anion-exchange materials of the weak-base polyamine and quater-

nary ammonium types. A resin with the complexing group benzyliminodiacetic acid is also available, as is one with the glycine group.

While the technology of synthetic ion-exchange resins in the broad field known as water treatment is highly developed, the chemical industry has not found many applications in other areas. This is not because ion-exchange resins have this limited applicability—quite the contrary. Instead, the potentially most useful applications in the chemical industry will require special materials, often specially prepared. Therefore, our emphasis will be placed upon materials other than those for water treatment.

Several years ago, the Norwegian chemist Skogseid1 showed that one could carry out many classical chemical reactions on an insoluble matrix. Skogseid treated polystyrene with nitric acid to produce polynitrostyrene, reduced this group to the anilinium analogue and then treated it with picryl chloride to produce a polymeric form of dipicrylamine (see Fig. 1). Dipicrylamine is the familiar potassium-specific reagent in analytical chemistry and, in resin form, it absorbs potassium selectively over sodium by a ratio of about 10:1. Skogseid also prepared a diazonium salt of poly-



styrene and from this a wide variety of compounds, one of which is also shown in Fig. 1. The work of Skogseid has led to the preparation of a number of resins having a specific affinity for certain metallic ions.² Complexing resins can also be prepared by polycondensation reactions.³ Thus, it would appear that an insoluble resin having almost any desired group either on its surface or fixed to its inner pore or gel structure can be prepared.

These new resin types will be discussed on the following pages.

Two resins based on polystyrene—Fig. 1

New Resins

In listing some of the interesting materials that have been prepared, mention should be made of the work of Miles' who treated a phenol-formaldehyde polymer with mercuric acetate to form the phenyl-Hg* fixed group, one which is specific for the absorption of mercaptans. Work on the preparation of organo-metallic polymers is continuing, particularly by Russian investigators.

Esters formed by the reaction of polymeric alcohols and hydrated metallic oxides were known for many years. This reaction was employed recently to produce molybdate resins that were able to absorb a number of sugars, amino acids and polyols selectively from concentrated salt solutions.5

A new and particularly interesting application has been the preparation of resins containing optically active groups that are capable of resolving racemic mixtures. While many attempts in this direction have been reported, some of the recent work by Rabek apparently shows considerable promise.

Another, most interesting resin is reported by Manecke who, starting with polystyrene containing either diazonium salt or isocyanate groupings, was able to couple proteins, enzymes and other, similar materials to the polymer without substantial loss of biochemical activity. Resins with attached antigens were capable of antigen-antibody reactions, and resins with appended enzymes showed considerable enzymatic activity. The applicability of these materials to the pharmaceutical and fermentation industries is certainly obvious.

Many resins containing groups capable of oxidationreduction reactions have been prepared. Cassidy has pioneered in this field with his vinylhydroquinone polymers, and further work by Manecke' and by Gregor and Beltzer' has led to materials of the same type. which are prepared by polycondensation reactions. For

example, the reaction between pyrogallol and formaldehyde can result in a stable and highly porous exchange material, one of considerable interest because of the strong reducing power of pyrogallol and the low cost of the resin. These insoluble redox resins can be reversibly oxidized and reduced through many cycles with apparently little loss in capacity as long as the oxidation is not too vigorous. In their reduced state, the resins can reduce iodine, oxygen to peroxide and hydroxide, and most metals from their higher to lower valent states, readily and with good capacity. Similarly, in their quinoid state, these resins act as mild oxidizing agents. In columns, they act as the organic analog of the Jones reductor but without the introduction of foreign material into the reaction mixture.

Conductive Redox Polymers

A new development is the preparation of redox polymers that also possess electronic conduction. Weiss, in Australia, has reported the preparation of oxidationreduction polymers that apparently possess eka-conjugation in their matrix structures. The ordinary redox polymers can also be made electronically-conducting by the incorporation of charcoal or graphite particles in their structure or by a physical admixture.* The recent work of Arnold and Murphy apparently follows along similar lines.

Stable oxidation-reduction polymers with electronic conduction would make feasible the electrical regeneration of ion-exchange beds. For example, a pyrogallol resin in the reduced R(OH), state could react with an alkaline sodium ion solution to form

 $R (OH)_2 + 2 Na^+ = RO_2^- \cdot 2 Na^+ + 2H^+$ Making the exchanger the anode of a cell would result in

$$RO_2^{--} \cdot 2 Na^+ - 2$$
 electrons = $RO_2 + 2 Na^+$

with the sodium ion migrating out of the resin, and reduction taking place at an external cathode. The resin is regenerated finally by reduction as the cathode. Cation exchange based upon very weakly acidic materials such as hydroquinone or pyrogallol is probably not too practical in neutral media; stable redox resins of stronger acidic character are yet to be prepared. Similarly, redox resins capable of anion exchange can be prepared but practical advances in this direction have not been reported. The availability of both these materials would make possible electrically regenerable deionization devices. It appears that the principal advantages to the use of electrically regenerable oxidation-reduction resin units would be in their convenience. For large units, the use of ordinary resins and chemical regeneration will probably be considerably more practical.

Oil-Swelling Resins

Another new and most interesting advance has been in the development of ion-exchange polymers capable of use in completely nonaqueous media, the so-called

oil-sw ment reacti and o other stron molec

The

effect

This

satur

be tr

deed,

almos

being

face.

Abs

water satist was a Th of str chara as be the r by th

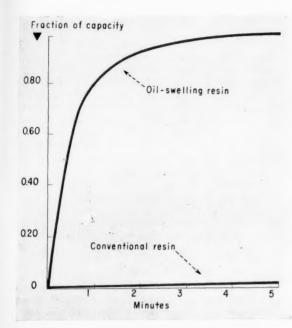
> For o to tr disso

CHEM

an oi

all of

in all



alde-

ange

the

cost

e re-

vcles

the

tate

and

wer

imi-

mild anic

duc-

oly-

, in

ion-

nju-

dox

by

in

ent

ong

nic

ra-

llol

an

re-

nd

'he

de.

te-

oly

ns

ed.

an

on

se

ole

d-

2-

ıi-

ed

Absorption of diethylamine from hexane, using an oil-swelling resin—Fig. 2

oil-swelling resins. With the conventional water-treatment resins, the rate-determining step of exchange reactions is almost invariably that of diffusion into and out of resin particles. It is only in water and other highly polar solvents that ordinary resins, being strongly hydrophilic, swell sufficiently to allow ions or molecules to diffuse at practical rates.¹⁰

The degree of cross-linking of these resins has little effect upon their permeability in nonaqueous solvents. This does not mean that water-immiscible solvents saturated with water or water-in-oil emulsions cannot be treated by water-wetted ion-exchange resins. Indeed, under these circumstances, exchange proceeds almost normally, with the rate-determining stop often being transport of material across the oil-water interface. It was shown that the demineralization of seawater in petroleum-oil emulsions could be carried out satisfactorily, particularly when a demulsifying agent was added.

The preparation of oil-swelling ion-exchange resins of strong acid, weak acid, strong base and weak base character that function efficiently even in solvents such as benzene or hexane has been achieved. Fig 2 shows the rates of absorption of diethylamine from hexane by the conventional sulfonic acid resin Dowex 50 and an oil-swelling sulfonic-acid polymer. It appears that all of the classical ion-exchange reactions can occur in almost any solvent system with oil-swelling resins. For example, an oil-swelling sulfonic resin was used to treat the nonionic ferric acetylacetonate complex dissolved in hexane, and a rapid rate of exchange of

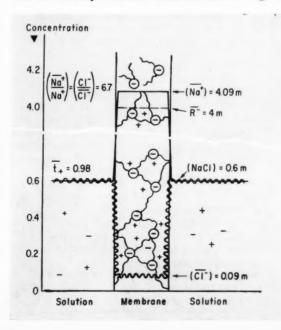
the hydrogen for the ferric ion with good resin capacity was obtained.

Many applications of resins suitable for use in non-aqueous media are evident. In the petroleum industry, they could be used to remove dissolved metallic impurities as well as a number of other materials too soluble in oil to be partitioned into an aqueous phase. These resins could be used for the uptake of fatty acids from edible oils, to solve a host of recovery and purification problems in nonaqueous solvent systems, and as acid or base catalysts.

Inorganic Exchangers

The original ion-exchange materials were inorganic; for many years, the natural zeolites were the only ones available. Inorganic exchangers have certain inherent advantages over organic polymers. They can be used at high temperatures (> 300 C.) while the conventional ion-exchange polymers, even under best conditions, are not ordinarily stable at temperatures higher than 150 C. Also, inorganic exchangers are essentially capable of showing a high degree of specificity in that they can exchange with one ion but not with other, similar, ions: in being crystalline, they can possess pores of extremely precise and uniform diameter. For example, the common feldspar mineral, orthoclase, shows a distribution coefficient for rubidium or potassium over sodium that is greater than 30:1; with organic exchangers, this value is not higher than 3:1.11 Other very sharp separations between highly similar materials by synthetic inorganic zeolites are

Membrane system for desalination—Fig. 3



known: the work of Barrar and the commercial development of molecular sieves may be cited.

Synthetic exchangers based upon the oxides, tungstates, molybdates and phosphates of zirconium have been known for some time; further advances in these directions have been reported by Kraus,12 and the Minnesota Mining and Manufacturing Co. has prepared inorganic exchangers in bead form. Work on new inorganic exchangers based upon inorganic polymers is under way. Andrianoff has reported the preparation of ion-exchange materials based upon some of his inorganic polymers, but definitive information is lacking. Developments in the next few years will probably produce inorganic exchange materials of real interest, possibly ones that are strongly acidic or basic. in contrast to the weak-acid and weak-base inorganic exchangers currently available.

It has been emphasized that many of the purely chemical (as distinguished from water-treatment) applications of ion-exchange materials call for resins not now available commercially. The technology involved in the preparation of new resins for specific applications is well-established and not particularly difficult. It is anticipated that we shall see the extensive development of specific resins for specific chemical applica-

Membranes

Ion-exchange membranes are essentially ion-exchange resins in the form of thin sheets. It has not been possible to make large sheets of highly crosslinked polymers because these are too rigid. Instead, membranes are made by either of two methods.

In the first method, ion-exchange resin beads are suspended in an inert plastic matrix, with the resinto-matrix polymer ratio such that most of the beads are in contact with one another. The preparation of these membranes is fairly straight forward and has been described in some detail by Beiber.18

Membrane Manufacturers— Table I

United States

American Machine and Foundry Co. Ionics, Inc. Nalco Chemical Co. The Permutit Co.*

Foreign

Asahi Chemical Industries Asahi Glass Co. British Water Softeners (Permutit Ltd.)* Imperial Chemical Industries T. N. O., Holland Toyo Soda Co.*

These heterogeneous membranes can be prepared directly from any granular resin, and many choices of matrix polymers are available. However, the membranes possess certain disadvantages since it is not possible to bond the hydrophilic resin particles to the hydrophobic matrix. Comparatively wide pathways across the membrane remain at these junctures; herein, precipitation can take place, colloidal matter can migrate and (as will be discussed later) the pathways allow a high electro-osmotic rate of water transport. Also, because of their heterogeneous nature, these films are intrinsically weak and must be fairly thick-increasing material costs.

Homogeneous ion-exchange membranes appear to be a single substance under the microscope. They are intimate molecular blends of largely linear film-forming polymers for matrix structure, and electrolytes for exchange groups; cage polymers or interpolymer mixtures are common.

Basic Principles

A number of laboratories are investigating the preparation of ion-exchange membranes; Table I lists current commercial suppliers of ion-exchange membranes of homogeneous and heterogeneous character. Some of these also make equipment; still others make equipment only.

One should think of a membrane as a concentrated solution of an electrolyte, where one of the ionic species is fixed to a matrix and the other (opposite in charge) is mobile. Within the membrane phase, the concentration of fixed and mobile ions is quite high, of the order of 4 to 8 molal* (moles per 1,000 g. of sorbed water). The thermodynamic concentration in a membrane should refer to sorbed water or molality rather than molarity or bulk concentration, because the latter term includes the inert matrix. Fig. 3 shows diagramatically a membrane system of the fixed anion, mobile cation type (a cation-exchange or cation-permeable membrane) such as a sulfonated polystyrene membrane in the sodium state in equilibrium with 0.6 m sodium chloride (approximately the concentration

Properties of Cation-Permeable Membranes— Table II

KCI M	Resistance Ohm Cm ²	C ⁺	Č-	D+ • 107	D~ • 107	Ť+
0.001	28	0.882	0.000	1.0		1.000
0.01	20	0.882	0.000	1.4		1.000
0.1	17	0.889	0.008	1.7	3.2	0.983
0.5	15	0.931	0.050	1.7	3.1	0.914
1.0	8	1.03	0.15	1.8	2.9	0.812

M is the molar concentration

MI. of 20.000

Gibbs

of sea equilib tion, c falling ing fre to rais the hi equilib change deviat: at equ spect : chloric diffusi brane The

trolyte ions w cation memb is also solutio of mo will ar tive p the ex of diff hance

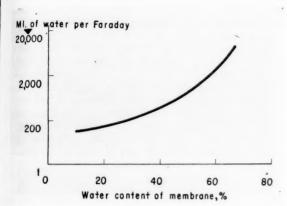
CHEM

^{*} These manufacturers make heterogeneous membranes; the others, homogeneous

^{*} The abbreviation "m" will be used for molal, "M" for molar.

is the concentration in the membrane phase.

is the effective diffusion coefficient in the membrane is the cationic transfer number.



red ces

m-

not

the tys

es:

ter th-

re, ly

be

n-

ng

or

f

Gibbs-Donnan equilibrium for ideal cation permeable membrane—Fig. 4

Dilute solution

Direction of ionic current

Effect of polarization on a cation

Effect of polarization on a cation permeable resin—Fig. 5

of sea waters). When the membrane in its water-equilibrated sodium form is placed into the salt solution, chloride ions enter the membrane spontaneously, falling down the concentration gradient and generating free energy. Some of this free energy is employed to raise sodium ions from the dilute solution phase to the high concentration level in the membrane, and equilibrium is reached when the net free-energy change is zero. Basic Donnan theory, which neglects deviations from ideal solution behavior, shows that at equilibrium the membrane is 4.09 molal with respect to sodium ions and 0.09 molal with respect to chloride ions or, therefore, that the concentration of diffusible sodium chloride is but 0.09 m in the membrane while the external solution is 0.6 m.

The Donnan equilibrium thus acts to exclude electrolyte from the membrane phase. Since the mobile ions within the membrane in Fig. 3 are predominantly cations, when an electric current is passed across the membrane, cations will carry most of the current. It is also evident from Donnan equilibria that when the solution concentration of salt is increased, the ratio of mobile cations to anions within the membranes will approach unity, or the membrane will lose its selective permeability to cations. By the same token, when the external salt concentration decreases, the exclusion of diffusible electrolyte by the membrane becomes enhanced and the ratio of mobile cations and mobile

General Membrane Properties—Table III

Thickness...... 25—250 microns, or 1—10 mils

Water content, Wt. %. 10 to 50

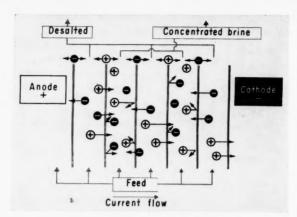
Molal conc., m...... 4 to 8 equiv./1,000

g. H₂O Transport no., 1 M KCI 0.80 to 0.97

anions approaches infinity. Accordingly, all ion-exchange membranes will show a high selectivity in dilute solutions, a lower selectivity in more concentrated solutions. It is also evident that a membrane usable in concentrated solutions must have a high concentration of fixed charges and that the ohmic resistance of a membrane will be relatively independent of the external salt concentration because its ionic composition changes so little with large changes in solution concentration. Ion-exchange membranes greatly retard the diffusion of neutral salts as such. For example, if a salt solution is placed on one side of a membrane and water on the other, the driving force for the diffusion of neutral salt across the membrane (the only species that can diffuse) will be proportional to the concentration gradient of the anion, and will be necessarily quite small.

Table II summarizes some of the fundamental properties of a cation-permeable membrane, taken from the data of Peterson and Gregor. This membrane was available some five years ago and had a fairly high ohmic resistance; membranes of one-tenth this resistance are available today. Table II shows that the molar or bulk concentration of cations within the membrane phase is fairly independent of the external salt concentration and that the concentration of anions increases sharply as the external salt concentration increases. Those systems follow the simple Donnan expression in a qualitative sense only, because activity coefficient corrections are large.

Table III summarizes some of the general properties of membranes presently available. It must be emphasized that a given membrane is not necessarily the best for a specific application. Membranes of particularly low resistance are best for concentrated solutions $(>0.1\ M)$; dilute solution resistances are so high that the resistance of the membrane counts for little by comparison. Further, the pore structure of a membrane may be important for a given application. Some indication of the pore structure of ion-exchange membranes can be determined by measuring the rate



Electrodialysis cell—Fig. 6

of diffusion of ions as well as of neutral molecules of different sizes.

For example, in a typical cation-exchange membrane, the following relative diffusion coefficients were measured: KCl, 55; urea, 23; arabinose, 3.7; glucose, 3.5; sucrose, 1.2; raffinose, 0.1; vitamin B12, 0.00. It is estimated14 that the pore diameters of most ion-exchange membranes vary from 7 to 12 Å, which should be compared with the estimated diameter of the hydrated potassium ion, which is 4 Å. A fine pore structure is required to maintain membrane selectivity, and it also precludes precipitation within the membrane phase, contamination by colloidal materials, etc. In general, homogeneous ion-exchange membranes have a considerably finer pore structure than do even the fairly highly cross-linked water-treatment resins; in consequence, they show a higher resistance to attack by biochemicals and microorganisms.

Membrane Stability

The chemical stability of ion-exchange membranes, while not as high as that of the ion-exchange resins, is quite adequate for most applications. An extensive survey of the properties of commercially available ion-exchange membranes carried out by Gregor's showed that several were capable of withstanding 1-M sulfuric acid or sodium hydroxide solutions at temperatures as high as 80 C. for several months without serious deterioration.

Membrane Electrodialysis

In most applications of ion-exchange membranes a direct ionic current is passed through the films, a phenomenon known as membrane electrodialysis. As will be seen later, electrodialysis acts to transfer ions from one solution into another, either with or against a concentration gradient. This passage of current creates a number of interesting phenomena. First, the passage of ions (particularly hydrated ones) through an ion-exchange membrane causes the simultaneous

movement of water, a phenomenon knowns as electroosmosis. Electro-osmotic water transport increases with pore diameter. Fig. 4 shows the electro-osmotic transport of sodium across a cation-permeable membrane where the pore diameter and therefore the water content was increased progressively. For desalting applications, a good membrane will show minimum electroosmotic water transport, for if the ratio of water to salt passing through the membrane approaches that in the solution being desalted, obviously nothing more than the transfer of solution from one side of the membrane to the other will be accomplished. On the other hand, electro-osmosis can be used to remove water and salts from large ions or molecules.

Fig. 5 shows the phenomena that occur when a direct current is passed through a cation-permeable membrane in contact with a salt solution. The effective thickness of the boundary layer (δ) is also shown. As direct current is passed, with cations moving from left to right when the steady state is reached, the flux of anions is zero in the boundary layer and a linear concentration gradient is formed. Solving the Nernst-Planck equation allows steady-state conditions to be calculated readily. This concentration polarization increases with current density, decreases with increased stirring adjacent to the membrane phase (lower δ), higher ion diffusivities and increased solution concentrations (on the polarizing side).

The Bethe-Toropoff Effect

As polarization increases to the point where the wall concentration approaches zero, a phenomenon known historically as the Bethe-Toropoff effect occurs with the forced hydrolysis of water; the hydrogen ions formed move to the right through the membrane, hydroxide enters the solution phase to the left. Those large pH shifts at the membrane faces are highly undesirable for they can induce precipitation and decomposition. Bethe-Toropoff polarization obviously increases the power requirement for the transport process and sets a practical limit upon the current density for a given system. An experimental and theoretical treatment of this phenomenon has been carried out. In theory, this phenomenon could be used to produce acids and bases.

The influence of the rate of stirring upon the occurrence of polarization is not pronounced. Gregor's measured the thickness of the boundary layer under a variety of experimental conditions and found that in open channels at a Reynolds number of about 2,000 δ was 100 microns, while increasing the Reynolds number to 5,500 lowered δ to 28 microns. Accordingly, high rates of stirring and high pumping costs are required to reduce δ markedly.

It is evident that in ion-exchange membrane electrodialysis, as in all other separation processes, an increase in the rate for a device of given size must give rise to an increased inefficiency in terms of power costs. As shown in Fig. 5, the required voltage rises from $E_{t=0}$ to E_{eff} . Polarization gives rise to pH shifts, and other undesirable effects occur. These can be mini-

mized of current decreased investm In elabout of ing inve

in elabout of ing involved themsel must have the result for one maprice of An e

direct of cation-j and who nate compress of faces of describe and multiple exchange of the cation of

sity. F
with a
in. for
salting
density
per hor
allowed
16 lb.
ion-exc
capacid
contra
change

knowle

are eff of mat branes of a la trated tions at con efficien

Appli

The syster chemi and he present costs, petiti saltin ess for to 10 dialys

CHEN

mized only by carrying out the process at reasonable current densities. For any given rate of production, a decrease in current density must call for an increased investment cost.

ro-

ith

18-

ne

n-

li.

'n-

to

at

re

n-

er

d

In electrodialysis equipment, it is estimated that about one-half of the entire cost of the process, including investment, power, etc., is that of the membranes themselves. It is evident that a desirable membrane must have a low ohmic resistance, a high ionic selectity and, at least of equal importance, a low cost. At the present time, commercially available membranes sell for approximately \$1/sq. ft. in large amounts; one manufacturer has claimed a projected membrane price of 35¢ on large production.

An electrodialysis cell is shown in Fig. 6, where a direct current is passed across a stack of alternating cation-permeable and anion-permeable membranes, and where concentration and desalting occur in alternate cells. The equipment used is similar to a filter press with solutions flowing across the membrane faces from a system of through-ports. Gregor has described the fabrication of simple laboratory cells and multiple electrodialysis cell similar to large-scale equipment for continuous operation.⁵

The desalting or concentrating capacity of an ion-exchange membrane unit can be estimated from a knowledge of the maximum permissible current density. For example, a stack having a volume of 1 cu. ft. with a spacing of 0.05 in. between membranes, or 0.1 in. for each cell or membrane pair, will have a desalting or concentration capacity at the low current density of 10 amp./sq. ft. of 4 lb. of sodium chloride per hour; at a current density of 40 amp./sq. ft. as is allowed in more-concentrated solutions, a capacity of 16 lb. of salt per hour is obtained. It is evident that ion-exchange membrane systems have a very high capacity in terms of salt removal or concentration, contrasted with the relatively low capacity of ion-exchange resin systems.

The two processes complement each other; the resins are efficient for the removal of relatively small amounts of material from large volumes of solution, while membranes are efficient for the removal or concentration of a large amount of material from relatively concentrated solutions. As an approximation, at concentrations above .01 M, the membranes are more efficient; at concentrations below .01 M, the resins are more efficient.

Applications of Membrane Systems

The many properties of ion-exchange membrane systems suggest that innumerable applications in the chemical industry will develop. The desalting of sea and brackish waters has been accomplished. At the present time, it appears that with current membrane costs, the ion-exchange membrane process is not competitive with other desalination processes for the desalting of sea water. It is, at present, the best process for the purification of brackish waters in the 1,000 to 10,000 ppm. range. It is estimated that electrodialysis units can desalt average brackish water at a

total cost (including investment and maintenance) of 25¢/1,000 gal.

In the chemical industry, solutions can be desalted, electrolytes can be concentrated, streams can be purified, and waste streams can be concentrated for easier disposal. For example, the production of sodium chloride from sea water is carried out on a large industrial scale in Japan. Sea water (3% salt) is concentrated to 18% or even to the point of saturation (26%). For this application, it is reported that membrane electrodialysis is more economical than such concentrating processes as evaporation and freezing.

Special Uses

Among the many special applications of ion-exchange membranes has been their proposed use in chlorine-caustic cells where membranes permeable only to sodium ions would allow the preparation of chloride-free caustic solutions. However, it is difficult to obtain a membrane that has a high selectivity in concentrated solutions and will withstand the corrosive conditions prevailing. On the other hand, the concentration of sulfuric acid from dilute solutions up to those 20% and higher in composition has been achieved. This suggests, too, that acid pickle-liquors and other similar streams can be treated by ion-exchange membranes.

These membranes can similarly be employed to separate ionic from neutral molecules. For example, it was shown earlier that the diffusion coefficient of potassium ions in a membrane was but twice that for urea, a particularly mobile non-electrolyte. An attempt to separate these two species on the basis of a diffusive process across the membrane would obviously be inefficient, but the imposition of an electric field makes a quantitative separation entirely feasible.

One can also separate materials having different degrees of ionization. For example, an excellent separation of many amino acids from one another has been achieved, including the separation of lysine from arginine and histidine. The quite difficult separation of proline from hydroxyline, two extremely similar amino acids, has also been performed. Those separations are by no means as sharp as those achieved by resin chromotography; with the resins, one obtains milligram amounts of extremely pure materials, while a small membrane unit can produce kilogram amounts of materials with a reasonable degree of purity.

It is of interest also to consider the possibility of employing ion-exchange membranes for the direct ultrafiltration of salt from saline solutions, a process also known as reverse osmosis. Extensive work by Ried and others has shown that certain plastic films, notably cellulose triacetate, are capable of screening out electrolytes while being permeable to water. The imposition of a direct hydrostatic-pressure sends water through the membranes with a good level of desalting but with an extremely low throughput.

With sea water, the equilibrium pressure is 400 psi., with working pressures of 800-1,000 psi. being required. Ion-exchange membranes also act as ultra-

filters, because a membrane impermeable only to either anions or cations will be impermeable to both by the electroneutrality requirement. A comparison of the rate of ultrafiltration through ion-exchange and cellulose triacetate membranes suggests that the former possess a superior potential for this application.

Little information is available on the possible use of ion-exchange membranes in nonaqueous media or ones containing relatively small amounts of water. The Donnan requirement suggests that the applicability of ion-exchange membranes under those circumstances will be limited, but direct experimental work is needed to confirm this.

Many questions have been asked concerning the extent of prior art in the field of ion-exchange membrane electrodialysis. An examination of the extensive literature shows that ion-exchange membrane technology is very old indeed, predating ion-exchange resin technology by many years. Electrodialytic desalting by the use of cation- and anion-permeable membranes was proposed before the turn of the century; units were in operation and patents applied for shortly after World War I. However, the membranes available at that time possessed a low ionic selectivity and a high ohmic resistance-and were highly unstable. Ion-exchange membrane electrodialysis became practical as a result of the pioneering work of Sollner, who prepared the first Permselective membranes, ones of high permeability and selectivity. The old and extensive background in this field suggests that the general applicability of ion-exchange membranes will not be restricted by patent considerations,

References

Skogseid, A., "Some Derivatives of Polystyrol," Thesis, slo, Norway, 1948.

Skogseld, A., "Some Derivatives of Polystyrol," Thesis, Oslo, Norway, 1948.
 Chen, C. H., Dissertation, Polytechnic Institute of Brooklyn, N. Y., (1957).
 Gregor, H. P., others, Ind. Eng. Chem., 44, 2834 (1952).
 Miles, H. T., others, J. Am. Chem. Soc., 76, 4041 (1954).
 Forkos, J., others, J. Polymer Sci., 53, 338 (1961).
 Menecke, G., Z. Elektrochem., 57, 189 (1953).
 Gregor, H. P., Beltzer, M., J. Polymer Sci., 53, 125 (1961).
 Gregor, H. P., others, to be published.
 Arnold, B. B., Murphy, G. W., J. Phys. Chem., 65, 135 (1961).
 Gregor, H. P., others, J. Phys. Chem., 59, 19 (1955).
 Hechter, O., others, J. Am. Chem. Soc., 81, 3798 (1959).
 Kraus, K. A., Phillips, H. O., J. Am. Chem. Soc., 78, 249, 694 (1956).
 Bieber, H. H., others, Ind. Eng. Chem., 50, 1273 (1958).
 Peterson, M. A., Gregor, H. P., J. Electrochem. Soc., 106, 1051 (1959).

Meet the Author



app

two

app

phy

is r

hur

the

atte

nia

cia

we

any

the

is 1

fac the fac av dis ab

(

HARRY P. GREGOR is professor of chemistry at the Polytechnic Institute of Brooklyn. He has a B.A. and a Ph.D. from the University of Minnesota.

In addition to his academic career, Dr. Gregor has industrial experience as a research chemist for The Permutit Co.

He has long been interested in ion-exchange materials, and was the first to make an ion-exchange membrane.

CONFERENCE REPRINTS AVAILABLE

Reprints on the entire series of articles on New Trends in Chemistry will shortly be available. The price of this 13-article, 108-page reprint is \$2 per copy, subject to quantity discounts.

For fastest service check No. 197 on your Reader Service Card in this or any subsequent issue.

The articles appeared in CHEMICAL ENGINEERING issues of the following dates:

October 16, 1961

High-Temperature and Plasma Chemistry, J. L. Margrave

High-Pressure Chemistry, R. H. Wentorf, Jr.

October 30, 1961

The Organic Semiconductor Challenge, H. A. Pohl

Chemical Kinetics-Expanding Field, M. Kilpatrick

Inorganic-Polymer Chemisty Points Way to High-Temperature Plastics, G. Barth-Wehrenalp

November 13, 1961

Solid-State Chemistry Gives Insight Into Crystal Behavior, F. V. Schossberger

Non-Aqueous Solvent Systems, J. J. Katz and I. Sheft Irreversible Thermodynamics, R. J. Tykodi

November 27, 1961

New Data on Metal-Complex Formation, A. E. Martell

Catalysis, V. Haenset

December 11, 1961

Progress in High Polymer Science, H. F. Mark and S. M. Atlas

December 25, 1961

Is Radiation Chemistry Practical?, P. Y. Feng

Using Ion Exchange Resins and Membranes, H. P. Gregor

Apply Fluidization to Gas Humidification

In this proposal for an adiabatic gas humidifier-cooler, a relatively shallow bed of fluidized solids provides the contact surface for saturating a gas with a given vapor.

NORMAN EPSTEIN, University of British Columbia

hesis, oklyn,

961).

249

2.00

ls,

A new approach to gas humidification is possible by applying fluo-solids contacting techniques. Although, two recent books^{2, 6} on fluidization discuss scores of applications of this technique to a wide variety of physical, chemical and metallurgical operations, there is no mention of any application of fluidization to gas humidification. Nor is there mention of this use in the large fluidization literature that has come to my attention.

This article shows how to apply fluidization techniques to gas humidification and the appropriate special measures necessary to effect it. By humidification, we mean the enrichment of any gas with the vapor of any liquid. While in practice the gas is often air and the liquid water, the term humidification as used here is not confined to any particular gas or liquid.

The basis for this proposal is the well-demonstrated fact^{1, 2, 4, 6} that in a dense-phase gas-fluidized bed, both thermal and diffusional equilibrium between the surface of the particles and the gas is established within a very short distance of the inlet gas distributor. This distance is usually less than 1 in. and almost invariably less than 3 in.

This means that when the fluidized solids are under-

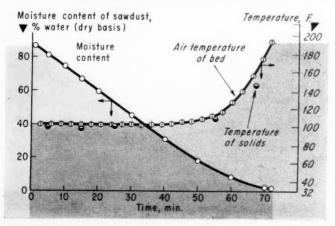
going constant-rate drying, at liquid compositions in excess of critical, the gas will be saturated with the vapor of the evaporating liquid, provided only that the bed depth exceeds the small value of 1 to 3 in. (For water removal, the liquid composition is known as the "critical moisture content.")

Furthermore, in the absence of external heating or cooling, both the outlet gas and the well-mixed solids will be at the adiabatic-saturation temperature of the incoming gas. In other words, the gas will follow an adiabatic cooling line to saturation in passing through the fluidized solids undergoing constant-rate drying.

These statements are exemplified by the fluidized drying of a -4-mesh screened hemlock-and-cedar sawdust, from British Columbia, in a 12-in. lagged steel column. Experiments were carried out by me at the Applied Chemistry Div. of the National Research Council of Canada during the summer of 1954.

Batches of sawdust containing up to 95% moisture on a dry basis were fed to the column and dried with metered hot air that was distributed through a 20-gage steel grid containing 112 holes, having r_0 -in. openings. Shielded thermometers, including a wet-bulb and a dry-bulb at the exit, were used to probe the column at

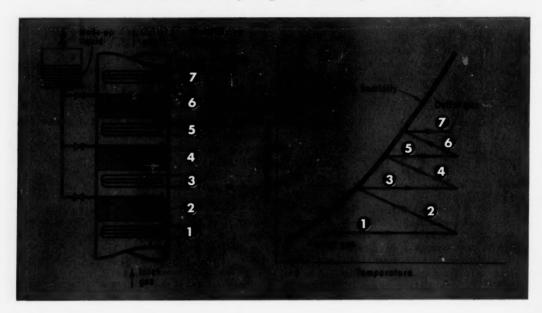
Determine critical moisture content of solids-Fig. 1



Initial conditions

Fluidized drying curves for cedar and hemlock sawdust. Inlet air rate = 494 lb./hr. Inlet air temperature = 306.1 F. Inlet air humidity = 0.002 lb.water/lb.dry air. Bed weight = 25.8 lb.dry sawdust

Gas humidification may require multistage unit-Fig. 2



various points. Sawdust samples were taken at frequent intervals for moisture-content analysis as well as for the measurement of solids temperatures.

For each run, a constant-rate drying period occurred, throughout which both sawdust and bed-air temperatures (including exit air) were constant and equal to the adiabatic-saturation temperature of the inlet air, while the exit air was saturated with water vapor. Neither horizontal nor vertical temperature gradients were observed in the beds. The sawdust thermometer was located 4 in. above the air-distribution plate.

Thus, the constant evaporation rate was in each case dependent only upon the condition and rate of the inlet air and was independent of bed weight or depth, which affected only the duration of the constant-rate period. The end of the constant-rate period was in every case marked by a sharp rise in bed-air temperature, with the sawdust temperature also rising, though lagging behind the air temperature. Throughout the course of a run, the column back-pressure kept decreasing because of the decreasing moisture content of the fluidized solids.

Test Run Proves Theory

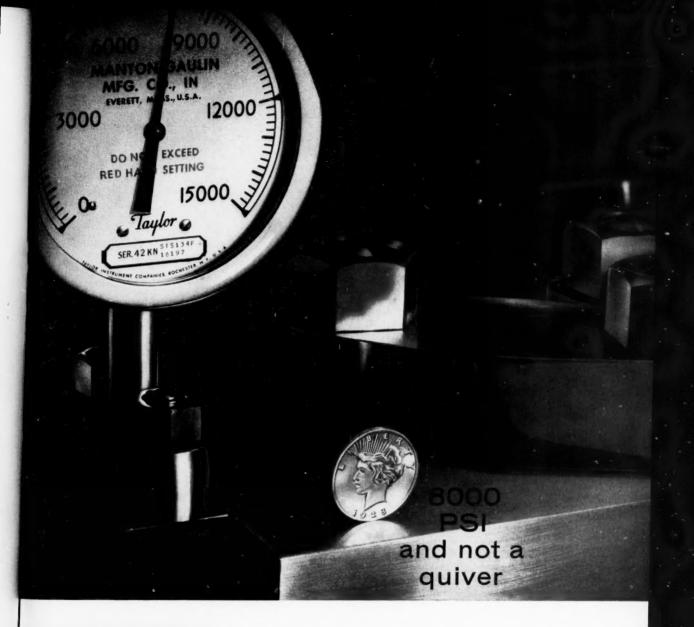
Data for a typical run are shown in Fig. 1. For this run, the bed depth during fluidization was about 60% greater than the original settled-bed depth of 4 ft. During the constant-rate period, which extended down to a moisture content of 30% (dry basis), the bed-air temperature was perfectly constant at 104 F., the adiabatic-saturation temperature of the inlet air.

The fact that the recorded solids temperature was slightly lower than the bed-air temperature can be attributed completely to the negative error arising from heat loss during sampling of the sawdust and during equilibration of the thermometer with the sawdust sample. The rate of water evaporation as determined from the constant-rate portion of the sawdust-drying curve is 0.046 lb. water/lb. dry air, a value that agrees well with 0.047 calculated from the assumption that the air followed an adiabatic humidification path to saturation.

A very simple method for continuously saturating a gas with a given vapor emerges from these observations. It is necessary only to maintain, at a constant value above the critical, the liquid content of a fixed charge of solids undergoing dense-phase fluidization. This is done by introducing liquid to the charge at the same rate at which it is being vaporized. Hence, we ensure that the fluidizing gas becomes saturated with the vapor of this liquid. The bed depth need only exceed a few inches.

The solids being fluidized should preferably be of low density to minimize pressure drop; of high internal porosity to ensure a wide range of liquid composition above the critical; and of not too wide a size distribution. And, in order to minimize particle entrainment, the solids should not be subject to easy attrition.

The sawdust of the above example (specific gravity = 0.4), with its fines removed and its moisture content maintained at about 50% (dry basis), would fulfill these requirements probably as well as or better than any other solid material, at least where water is the evaporating liquid. A settled-bed depth of 5 in., fluidized to a depth of about 8 in., would require a total pressure drop of only 2 in. of water. About half of this drop would be due to the weight of sawdust supported, while the other half would be assigned to





GAULIN TRIPLEX PUMPS Cost Less to Run and Maintain

High or low pressure, a Gaulin operates vibration-free . . . and in perfect balance. And so accurately, it's ideal for metering.

But whether you use it for transfer, spray drying or metering, Gaulin's horizontal design costs less to run and maintain.

And to give you more guts to take the heaviest loading without strain or failure, a Gaulin weighs *up to one-third more*. Gives you *years more service* free from repairs or replacements.

Couple this with Gaulin's more efficient drive, its greater safety for abrasive or hazardous materials, and its easier cleaning — and you know why Gaulin Triplex's are preferred by the men who run them.

Capacities from 50 to 7500 GPH . . . pressures from 500 to 12,000 PSI.

See your Chemical Engineering Catalog for the name of your local Gaulin representative.



71 Garden Street, Everett 49, Mass.

a gas distributor having a high but feasible porosity.

As in our example, assume a superficial gas velocity of 2.5 ft./sec., and an additional column height of 10 in., to minimize particle entrainment. Then, for a given gas load, the resulting volume of the unit would be similar to that of a spray chamber.3 The decrease in length relative to a standard spray chamber would be approximately equal to the increase in required cross-section.

Advantages of the Fluo-Solids Humidifier

The primary advantage of the unit compared with a conventional spray chamber, which also has low pressure drop, is that the proposed unit does not require liquid recirculation. In a spray chamber, the continuous recirculation rate of liquid is some 10 to 100 times the rate of liquid actually vaporized. In this chamber, the make-up rate required to maintain steady-state conditions equals the vaporization rate.

In the present unit, the mass-transfer equivalent of liquid recirculation is furnished by the fluidized solids. Their liquid content is kept above the critical content and their surface area provides the liquid-gas interface, which in the spray chamber is supplied by the atomized drops of recirculating liquid. Thus, the substantial power expenditure required to maintain liquid circulation in a spray chamber is avoided in the present equipment.

Make-up liquid to the fluidized solids can be added by any one of a number of standard liquid distributors located at the top of the expanded bed. A simple perforated pipe would be more than adequate for the present purpose, especially in view of the relatively small trickle of liquid that would normally be required and the excellent blending characteristics of the fluidized bed itself. In the test unit, the make-up rate was 220 cm.3/(min.) (sq. ft. of bed cross-section).

As in a spray chamber, adiabatic humidification of the gas presupposes that the make-up liquid enters at the adiabatic-saturation temperature of the inlet gas. But in most cases the quantity of evaporation would be so small, relative to the total holdup of solids and their liquid content, that minor deviations from the adiabatic-saturation temperature for the make-up would have little effect on the humidification path of the gas.

The required make-up rate could be computed from a knowledge of the inlet gas rate, humidity and temperature, using a psychrometric chart for the given gas-liquid system. This computed rate would have to be maintained as an average over a long period of time. However, due to the large span of permissible liquid content above the critical, considerable fluctuations from this average could be tolerated without in any way affecting the gas humidification.

In the moist sawdust example, an acceptable quality of fluidization could be maintained up to a moisture content of 100% (dry basis). As the pressure drop across the proposed sawdust bed would increase (due to weight gain of the bed) by about 12-in. of water over the permissible moisture content range of 30 to

100% (dry basis), differential pressure could be utilized to control the rate of make-up water. Such control would be particularly appropriate at the less-pronounced upper limit of acceptable moisture content, above which the sawdust gets too soggy to fluidize properly.

At the lower limit, below which the gas no longer describes an adiabatic-humidification path and does not leave saturated, the sudden rise in temperature of the exit gas at the beginning of the falling-rate drying period can be utilized to institute a finer control on make-up liquid rate than that furnished by differential pressure.

Cooling of the gas accompanies adiabatic humidification. In fulfilling particular gas conditioning requirements, this cooling effect may have to be taken into account. As is the case for a spray chamber, preheating, afterheating or both may be necessary for the gas undergoing humidification. On the other hand, this cooling effect may be the primary purpose of the process especially for room-temperature air.

Sometimes, several stages in series of alternate heating at constant humidity and adiabatic humidification may be required to effect a desired humidity, and possibly temperature change, without excessive heating of the gas at any one stage. Such a multistage fluidization, along with the accompanying psychrometric paths followed by the gas, is illustrated schematically in Fig. 2.

Unlike a spray chamber, a one-stage fluidization unit with bed depth in excess of 3 in. can produce 100% humidity gas at the adiabatic-saturation temperature if the column is adequately insulated. If less than this degree of humidification cooling is desired, then an appropriate proportion of inlet gas can be bypassed to meet the outlet gas. The amount to be bypassed can be computed stoichiometrically and controlled by means of outlet humidity or temperature.

References

- 1. Heertjes, P. M., de Boer, H. G. J., de Haas van Dorsser, A. H., Chem. Eng. Sci., 2, 97 (1953).

 2. Leva, Max. "Fluidization." McGraw-Hill, New York, 1959.

 3. Perry, J. H., "Chemical Engineers Handbook," 3rd ed., p. 778, McGraw-Hill, New York, 1950.

 4. Richardson, J. F., Ayers, P., Trans Instn. Chem. Engrs., 37, 314 (1959).

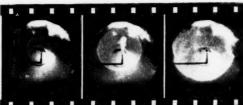
 5. Treybal, R. E., "Mass Transfer Operations," p. 138, McGraw-Hill, New York, 1955.

 6. Zenz, F. A., Othmer, D. F., "Fluidization and Fluid Particle Systems," Reinhold, New York, 1960.

Meet the Author

NORMAN EPSTEIN is associate professor of chemical engineering at the University of British Columbia, Vancouver, Canada. On sabbatical leave during the current academic year, he is at the department of chemical engineering, Cambridge University, England. He received a B.E. and an M.E. in chemical engineering from McGill University and a D.E.S. from N.Y.U. Dr. Epstein has written articles on the various aspects of momentum, heat and mass transfer.

Unsuppressed blast in test chamber, shown in high-speed photos, rapidly expands from ignition (left) to fill the entire chamber (right). Elapsed time is 50 milliseconds.



Explosion Suppression: New Safety Tool

be uti-

ch coness-procontent, fluidize

longer oes not of the drying rol on rential midifing re-

taken , prey for

hand,
of the

heatation l posating diza-

oaths

y in

unit 00% iture

this

n an

ssed

can

eans

sser.

959. ., p.

37,

Mc-

icle

cal

in-

gi-

 α

as

at

Split-second suppression system, coupled with conventional explosion prevention methods, minimizes potential hazard.

CLAYTON B. HAMMOND Monsanto Chemical Co.

Many chemical process industries have an inherent potential for fire and explosion.

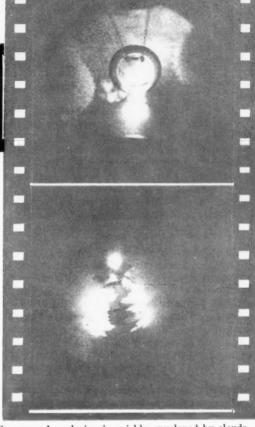
But, at its Plastics Div. in Springfield, Mass., Monsanto Chemical Co. has minimized this potential with a combination of explosion prevention, explosion control and a new explosion-suppression system.

Explosion suppression represents an active rather than passive approach toward greater explosion protection. It consists of detecting the explosion and suppressing or extinguishing it before it reaches a critical point. Because of success with a pilot installation, Monsanto has installed three more of these systems, a fourth is in the design stage, and others are under consideration.

Monsanto's Springfield plant produces 215 plastic formulations from organic chemical raw materials in gas or liquid form. Among these chemicals are styrene and vinyl monomers, which present definite fire and explosion hazards prior to their conversion to commercially usable plastic materials.

Explosion Theory Reviewed

An explosion is really nothing more than an extremely fast fire, characterized by the rapid release of energy. Like a fire, it has three essential ingredients—a combustible material, oxygen and a source of ignition. In addition, for a fire to become an explo-



Suppressed explosion is quickly enveloped by clouds of extinguishing mist. Suppressant bottles, mounted at each side of chamber, discharge within a few milliseconds after ignition of the charge.

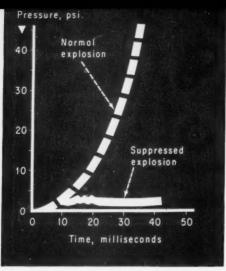
sion, it must occur within a confined volume, and the combustible material must be in the form of fine particles—fine dust in suspension in the case of a solid material, vapor in the case of a flammable liquid—distributed in flammable concentrations throughout the volume.

The two primary physical effects of any explosion are heat and pressure, and the latter presents the greater hazard to personnel, structures and equipment. Although an explosion flame is of high intensity, it is of extremely short duration and is not a great problem, except for the possibility of its igniting a secondary fire or explosion.

The type of confinement of the hazardous material greatly influences the extent of the hazard. In general, the greatest danger exists in small vessels, rooms or buildings because it is difficult to obtain suspension of particles in larger vessels. Also, the larger confined volume can absorb more pressure buildup, and is somewhat self-venting.

Particle size also affects explosion hazards—the smaller the particle, the more easily it is suspended in air, and the more easily it is ignited.

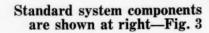
The hazard of vapor explosion exists in such gas-

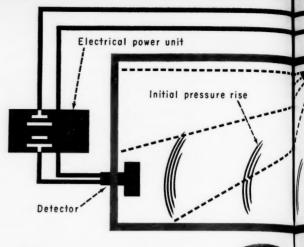


Pressure buildup is kept to 1-5 psi.—Fig. 1

) ::2 :

МΙ







Power unit with standby batteries



Pressure sensitive explosion sensor



High-speed value for isolation

actuate

fired equipment as burners and ovens, in storage tanks, and areas where flammable liquids are handled. In general, gases are more easily dealt with than dust because they are handled in closed systems. Thus, it is usually possible to exclude potential ignition sources and design the equipment to contain explosive pressures.

Although theoretically less violent than a vapor explosion, the practical result of a dust explosion is about the same. Dust explosions are much more difficult to prevent or control because the processes in which dust is created are seldom completely enclosed. Grinding, crushing, conveying and drying are often involved, and enclosure of such equipment in pressure-resistant structures, if possible at all, would be prohibitively expensive.

Explosion Prevention

The fundamental method of preventing explosions is to avoid the simultaneous occurrence of fuel, oxygen and ignition source.

Ignition temperature and energy requirements vary widely, and some materials require very little energy to react. Therefore, open flame, static electricity and other potential sources of ignition must be eliminated. Electrical equipment should conform to the National Electrical Code and to local regulations. Proper installation and maintenance are also important.

Preventing accumulation of combustible material is primarily a matter of housekeeping. Buildings and equipment should be regularly washed and vacuumed, but caution is required when cleaning dust accumulations. Turbulence created by high-pressure hoses can

cause dust suspension in the air and create an explosive condition. Vacuum systems pose severe static discharge problems, and should be well grounded, with the grounds tested frequently.

At Springfield, we have developed techniques to simplify cleaning and call attention to poor housekeeping. Ledges, nooks and crannies where dust might accumulate have been eliminated as much as possible. For example, I-beams are boxed with sheet metal, and dust-prone surfaces are painted with a color contrasting to that of the dust being handled.

Elimination of oxygen is more difficult and may be limited by the process under consideration. Inert gases can be used to blanket flammable liquids in a closed system, and an inert inorganic material, such as rock dust, can be added to the system where a dust hazard occurs.

Explosion Control

Control of an explosion's effects is the second conventional step. Until recently, it was the final step, and the only one designed to deal with the explosion itself upon failure of the preventive measures. The basic technique is to vent the area or equipment to allow safe release of pressure and heat to the surrounding atmosphere.

Many factors must be considered in the selection of suitable vents. The first is the strength of the structure enclosing the hazardous area. A heavy masonry wall, for example, will withstand pressures up to 10 psi., but maximum explosion pressures will almost always exceed this figure—a typical plastic dust explosion can develop 100 psi.

Basic suppression system consists of sensor and suppressor—Fig. 2

Suppressor

Flame front

Ignition source

Discharge — bottle
Spring Chain

Rubber plug

Hemispherical suppressor charge bottle

Position of the vents relative to the point of potential explosion is also important. They must be located so that the pressure will reach them in a direct, unobstructed line—explosive pressures don't turn corners.

Empirical methods for computing venting requirements have been developed, based generally on strength of building materials, volume to be vented and explosion characteristics of the combustible material. For less-critical problems, there are ratios of venting area to volume of enclosure that are based on generally accepted practice (National Fire Codes, Vol. II, Combustible Solids, Dusts, Chemicals and Explosives, National Fire Protection Association, Boston, 1959, Section 68).

Explosion Suppression

sive

dis-

vith

im-

ng.

ecu-

For

and

on-

be

ses sed

ock

rd

n-

p.

on

he

to

l-

n

c-

t

In 1959, we installed a pilot explosion-suppression system at the Springfield plant. Developed in Britain, this system was introduced in the U.S. by Fenwal Inc., Ashland, Mass.

The system operates on the basis that, although an explosion appears to be instantaneous, there is a lapse of time between ignition and buildup of destructive pressures. This time is in the order of several thousandths of a second. The system senses the explosion and takes action before pressures become destructive.

Fig. 2 shows a schematic of the basic suppression system and Fig. 1 shows a graphical comparison of pressure buildup vs. time for a normal and for a suppressed blast. The lead illustrations compare suppressed and unsuppressed explosions with high-speed photographs.

The explosion detector, which is the heart of the system, can be either a pressure-sensitive device or a radiant-energy detector. The pressure detector is sensitive to either the rate of pressure rise or to a specific static pressure, or both. The radiation detector selectively senses certain wavelengths of the spectrum that exist in an explosive flame.

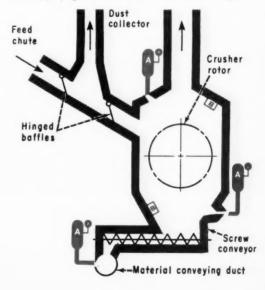
The detector signals the power unit, equipped with stand-by batteries in case of power failure, which activates the various explosion-protection devices. All of these devices are operated by explosive detonators similar to the precision electric blasting caps used in seismic exploration. The actions performed include suppression of the explosion, venting of the confined space, isolation of the explosion, advance inerting of associated areas, and automatic shutdown of equipment or plant.

There are two types of suppressor—easily ruptured hemispherical containers, or high-rate discharge bottles. Both contain a liquid suppressant that is dispersed in fine particles at speeds up to 600 ft./sec. The incipient explosion is cooled by heat of evaporation of the enveloping mist, thus inhibiting further combustion. Only small quantities of suppressant are required because of its high discharge rate. For example, only 5 cc. of water or 2 cc. of bromochloromethane are required to suppress an explosion in a 1-gal. volume.

System vents are glass windows that are fractured by an explosive detonator mounted against their outer face. The elevated pressure within insures that glass fragments will fly outwards, away from the protected space and process.

Isolation is secured with butterfly or flap valves that are held open against heavy spring pressure by

High-rate bottles (A) and pressure sensors (B) protect hammermill—Fig. 4



a hollow metal link. A detonator within the link breaks it, allowing the spring to slam the valve closed. Fig. 3 shows standard system components, including a modified discharge bottle described below.

A Pilot Installation

Our first system was installed in a hammermill that crushes large pieces of plastic. As in any crushing operation, this one is very dusty, and the plastic dust is combustible. Also, it is virtually impossible to prevent tramp metal from entering the system and causing sparks when struck by the hammers.

Fig. 4 shows schematically how the suppression system is installed in the crusher hammermill. Four pressure-sensitive explosion detectors are installed in the crusher chamber, two above and two below the rotor. Four externally-mounted high-rate discharge bottles protect this space. A fifth is mounted to inert the product-conveying duct and prevent transmission of an explosion through it. The crushing chamber is vented to atmosphere through a 28-in. duct, leading from the top of the chamber through the building roof. Hinged baffles in the feed chute afford some protection to the dust collector and the operating area.

Initially, we installed hemispherical suppressors in the crusher because they would discharge more quickly. But they could not withstand the constant impact from flying pieces of plastic, and we replaced them with high-rate bottles containing bromochloromethane suppressant.

To prevent plastic dust from collecting and fusing in the nozzles, special nozzles and plugs were designed, as shown in Fig. 3. The plugs are designed to blow out easily upon discharge of the bottles. All five suppressant bottles can operate simultaneously from any two detectors.

The system demonstrated its effectiveness on May 27, 1960, when a dust explosion occurred in the crusher. The explosion occurred just before the equipment was to be shut down. The operator was standing at the control panel as the plastic hit the crusher hammers. He saw a flame above the crusher followed by black smoke. Other personnel saw the flash, followed by smoke and fumes originating from the explosion suppressant. The pressure developed by the explosion was contained within the crusher and released through the vent. The baffle arrangement in the feed chute apparently minimized discharge of pressure and plastic through it. Total damage to the crusher itself was deformation of the access plate in the lower part of the feed chute.

A flame passed through the dust-collector duct and entered the bag collector on the roof, which was not protected by the suppression system. Above the roof line, where it makes a 90° turn, the duct was blown open. A secondary flash in the collector vented itself through the side panels and was extinguished. There was no major damage to the collector, and the duct and side panels were easily replaced.

The source of ignition could not be determined, but it is assumed that a tramp-metal spark was probably the culprit. Careful search of the crusher after the explosion turned up small quantities of metal chips in the equipment.

Based upon the appearance of the equipment, the maximum pressure attained was 4-5 psi. If unsuppressed and uncontained, an explosion of this type could reach a maximum pressure of 65-100 psi.

Ideally, the suppression system should limit maximum pressure to 1-2 psi. However, the ignition appeared to have occurred in the upper section of the chambers, and the detectors there had been disconnected pending a revision necessitated by the extreme vibration of the unit. Thus, the pressure buildup had to be sensed by the detectors in the hopper below the rotor. This slight lag, coupled with the slower action of the discharge bottles that had been substituted for the hemispherical suppressors, probably accounts for the slightly greater than ideal pressure experienced in this case.

Nevertheless, the investigating engineers concluded unanimously that the protection system had been effective in limiting the pressure buildup to a safe level, and similar systems were immediately installed on two other plastic crushers.

The investigating group also recommended a number of minor changes, although the basic system itself remains the same. For example, the electrical controls of the crusher motor, conveyor screw, crusher feeder and collector fan, and dust collector fan have been interlocked with the suppression system for automatic shutdown when the suppression system is activated.

Although our experience shows the effectiveness of the suppression system and its value in some applications, it does not replace the protection methods previously used. Such practices as venting, good maintenance and plant housekeeping are still necessary to prevent and control explosions.

> Meet the Author



CLAYTON B. HAMMOND is superintendent of the engineering section in the plant engineering department at Monsanto Chemical Co.'s Plastic Div. plant in Springfield, Mass. He joined Monsanto in 1951, following his graduation from Norwich University where he received a B.S. in mechanical engineering. Hammond started as an area engineer and attained his present position in 1959. He is a member of ASME.

М

Recent CHEMICAL ENGINEERING survey shows that employment centers at AIChE meetings would be welcomed, but that engineers may not be aware of currently existing aids.

Will your next move be easy to make? To that question, one engineer—a veteran of 14 years in the process industries—answered, "I seem to have no job mobility; I feel trapped."

Responding to a recent request in these columns (Chem. Eng., Oct. 16, p. 204), 124 other readers—most of them members of AIChE and/or ACS—filled us in on the frustrations and satisfactions of carving out an engineering career path in industry today. The men who responded work in most segments of the process industries—from "chemicals and petrochemicals" (33) to "stone, clay, glass and ceramics" (1).

In age, the respondents to the job-mobility survey range from two youngsters just out of school to two old timers of 30-35 years experience. By far the greatest number

of them fall in the 30-40 age group. Over half have been with their present firm five years or less; just half have had either one or two previous jobs. To make their last job change, they chose, nearly equally, five or six methods of contact with employers. Major reasons for their last change: wanted more opportunity or responsibility; had been laid off; wished to change industry, function or location; desired higher pay.

Those are some highlights from the job-mobility survey. Details follow in tables and charts on the succeeding pages. Several important points can be gleaned from the figures and from comments of the respondents:

 AIChE members do not seem aware of the range of employment services that is available to them.

· Most AIChE and ACS mem-

Engineers Look for

Chemical

the hips

the

suptype

ap-

the

eted

ora-

be tor

the

the

the

in

ded

fec-

vel.

wo

m-

elf

ols

ler

en

tic

ed.

of

ea-

reteto

More Help in Finding New Jobs



ABOUT CHANGING YOUR JOB

USED AMERICAN CHEMICAL SOCIETY CLEARING HOUSE

All ACS members Those who used
Those it helped = 5

USED ENGINEERING SOCIETIES PERSONNEL SERVICE AGENCIES

All AIChE

Those who used

Those it helped

Those it helped

Those it helped

USED OTHER SOCIETY-SPON-SORED EMPLOYMENT SERVICE

All AlChE
Those who used

ACS, AlChE ads

Other

WOULD YOU FAVOR AICHE-SPONSORED EMPLOYMENT CENTERS AT MEETINGS?

All AIChE
Those who do
All ACS
Those who do

PPPP P = 10

bers who replied favor AIChE-sponsored employment centers at Institute meetings.

• Most who have used such well-known services as the ACS clearing house and the Engineering Societies Personnel Service, Inc., (ESPS) have not found them helpful in gaining a job.

Some Present Job Helps

That AIChE members may not be fully aware of what help is now available to them from their society is apparent from suggestions of those who favored more AIChEsponsored employment services. Many of them named areas that a full-time, experienced staff man at the Institute now administers. His major services include, besides sitting on the board of ESPS, assembling two bulletins—"Situations Wanted" and "Openings for Chemical Engineers."

The first bulletin is a preprint of notices that appear in Chemical Engineering Progress, an official AIChE publication. Members are permitted two such free notices annually. Mailed first-class to any personnel men or other executives who request it (there are now 3,200 on the mailing list), the preprint stimulates inquiries from jobofferers before the magazine is mailed. The October bulletin, for example, produced 420 such inquiries within 10 days of mailing, which were forwarded by AIChE to the 29 listed chemical engineers.

A newer service, "Openings for Chemical Engineers," was just started in October. Containing brief descriptions of jobs offered by recruitment advertisers in *Chemical Engineering Progress*, this free bulletin also is mailed before the magazine. It goes to members who are looking for a job—as indicated by situation-wanted notices filed with the Institute—as well as local-section officers and others.

Both these bulletin services protect the job-seeker until he decides to follow up specific interest shown by an employer. And AIChE quickly transmits (same-day service) data between the two parties.

Peripheral services at AIChE's national headquarters include an upto-the-minute listing of job openings, and a list of employment agencies and recruitment firms that might be interested.

One other service is the Engineering Societies Personnel Service, Inc. A nonprofit employment agency run by the "founder" societies—including AIChE—it operates out of New York, Chicago and San Francisco offices. You can register either by letter or resume if you are interested in openings listed in society journals. If you take a job as a result, a 4% placement fee is required. Often, the hiring company will pay all or part of it. Available, too, from ESPS, is a weekly bulletin

of job openings that costs \$4.50/-quarter.

Dim Outlook for Meeting Service

Despite these services, respondents to the CHEMICAL ENGINEERING survey overwhelmingly favored AIChE-sponsored employment centers at meetings. AIChE-member respondents, who would have most to gain from such an arrangement, and ACS-member respondents, who have already seen such an operation in their society-run clearing house, clearly believe there is a need. Whether there is or not is arguable.

Those who argue for a meeting marketplace defend a stand now taken by New York recruitment firm Deutsch & Shea. Originally proposing to society executives a one-year ban on all recruiting activity, the firm has since come to believe that society-sponsored employment centers, similar to the ACS clearing house, might be easier to run and control. Advantages of such centers include convenience and speed for the job-hunter, and elimination of behind-the-scenes piracy (now, some say, tacitly encouraged by AIChE).

Sources close to Institute affairs point out, however, that running such a service is an expensive proposition—especially since only half of one percent of the membership is interested in finding a job at any given time. Too, only 25% of the membership attends national meetings each year.

NUC

Thr

rien

ice

sinc

rese

ally

of N

fect

high

grap

mor

par

mer

erai

rece

Car

pas

pro

grap

equi

of t

invi

plic

CH

T

The same sources, moreover, hold that company opposition is a major deterrent to action, that firms who support the Institute and also send engineers to its meetings won't condone a formal arrangement that lets competitors hire those same engineers away.

There's at least one other argument against the clearing house operation, and that's a pragmatic one. Of all ACS members replying to the survey, only half had used this ACS service at meetings. And of those who did, only one-fifth found it helpful in obtaining a job. (Five respondents had tried the Career Center service of New Yorker Bill Douglass, all without success.)



0/-

ce

nd-ING red en-

oer ost

ho

ion se,

le.

ow ent

lly

ac-

to m-

he

of ice nd ies

ng

lf

ip

ny

he

et-

ld

or

ho

hr

ıg

h

b.

IG

NUCLEAR GRAPHITE NEWS

from NATIONAL CARBON COMPANY

DIVISION OF UNION CARBIDE CORPORATION, 270 PARK AVENUE, NEW YORK 17, N. Y.

OFFICES: Birmingham, Chicago, Houston, Los Angeles, New York, Pittsburgh, San Francisco. In Canada: Union Carbide Canada Limited, Toronto

NO OTHER MATERIAL HAS SO MANY USEFUL NUCLEAR PROPERTIES

- . EXCELLENT STRUCTURAL MATERIAL
- RESISTS CORROSION
- . RESISTS THERMAL SHOCK
- EASILY FABRICATED
- HIGH MODERATING QUALITIES
- STRENGTH INCREASES WITH TEMPERATURE RISE

NUCLEAR GRAPHITE RESEARCH COVERS ALL PHASES AT NATIONAL CARBON

Three-quarters of a century of experience in carbon/graphite, and service to the nation's nuclear program since its beginning, are behind the research and development continually in progress at three laboratories of NATIONAL CARBON.

Extensive study of irradiation effect on graphite; development of higher purity and lower permeability graphite; the production of larger monolithic blocks; carbon-coated fuel particles; graphite matrix fuel elements; new techniques for close-tolerance machining, are all subjects receiving constant effort at National Carbon Company.

Through its combination of unsurpassed research, engineering, and production facilities for nuclear graphite, NATIONAL CARBON is fully equipped to meet the special needs of the industry. NATIONAL CARBON invites discussion of any potential application of graphite.

Building of Test Reactors Continues Under University Research Programs



This graphite reflector for a test reactor is similar to the type now being constructed for the Georgia Institute of Technology by O. G. Kelley & Company

More and more colleges and universities are expanding their research programs to include nuclear reactors. One of the latest additions at the university level is the nuclear facility now under construction on the grounds of the Georgia Institute of Technology in Atlanta, Georgia.

Nuclear graphite from NATIONAL CARBON is used in the reflector, which is similar to the type shown in the above illustration.

The Georgia Tech Research Reactor was designed to satisfy as many requirements in a broad research program in nuclear science as possible. Its breadth of utility not only embraces classroom practices and material testing, but also serves as a basic research instrument for ad-

vanced experimentation, including medical research.

The Georgia Tech reactor is very similar to the CP-5 Argonne Research Reactor and, in some respects, the MIT reactor. It will have an initial power rating of 1000 kw, with an eventual capacity of 5000 kw.

Since its pioneering use in the first reactor at Stagg Field, University of Chicago, "National" nuclear graphite has been increasingly employed in applications such as: moderator, reflector, thermal column, fuel element concepts, and control rods. Extremely resistant to thermal shock, and with no danger of melt-down, graphite is the logical solution to the higher-temperature reactors of the future.

"National" and "Union Carbide" are registered trade-marks for products of

NATIONAL CARBON COMPANY



ABOUT YOU AND YOUR JOB

Industry	
Chemical & petroche Petroleum refining &	emical33
Metallurgical & met	al products
Plastic materials, et	al
Wood, pulp, paper Engineering & const	& board7
Other	49
TOTAL	125
Age Group	
20-24	
25-29	
30-34	
40-44	
45-49 50-54	6
55-59	
Years With Firm	
1 year19	109
218	112
311	122
4 10 5 12	131
613	151
79	>154 Unknown3
83	Unknown
94	
Years in Present Pa	
	74
Years in Present Po 1 or less	74 81 90
Years in Present Po 1 or less 33 2	7
Years in Present Po 1 or less	7
Years in Present Po 1 or less	7
Years in Present Po 1 or less	7
Years in Present Po 1 or less	7
Years in Present Po 1 or less	7
Years in Present Po 1 or less	7
Years in Present Po 1 or less	7
Years in Present Policy 1 or less	7. 4 8. 1 9. 0 10. 4 >10. 3 Unknown 1 s Firms 6. 1 7. 3 8. 1 11. 1 12. 2 Unknown 2
Years in Present Policy 1 or less	7. 4 8. 1 9. 0 10. 4 >10. 3 Unknown 1 s Firms 6. 1 7. 3 8. 1 11. 1 12. 2 Unknown 2
Years in Present Policy 1 or less	7. 4 8. 1 9. 0 10. 4 >10. 3 Unknown 1 s Firms 6. 1 7. 3 8. 1 11. 1 12. 2 Unknown 2
Years in Present Policy 1 or less	7. 4 8. 1 9. 0 10. 4 >10. 3 Unknown 1 s Firms 6. 1 7. 3 8. 1 11. 1 12. 2 Unknown 2
Years in Present Po 1 or less	7. 4 8. 1 9. 0 10. 4 >10. 3 Unknown 1 s Firms 6. 1 7. 3 8. 1 11. 1 12. 2 Unknown 2
Years in Present Policy 1 or less	7
Years in Present Policy 1 or less	7
Years in Present Policy 1 or less	7. 4 8. 1 9. 0 10. 4 >10. 3 Unknown 1 s Firms 6. 1 7. 3 8. 1 11. 1 12. 2 Unknown 2 Unknown 2

ABOUT YOUR LAST JOB CHANGE

Most Frequently N	Nentioned Reas	ons
More responsibility	or opportunity.	.38
Layoff		.19
Change industry or	function	.15
More pay		9
Relocation		7
Unsatisfactory mana	gement	6
Other		.10
Length of Time Ou		
082	2 months	6
1 week1	3	
21	4	
31	6	
43	8	
62	2 years	1
72		
Method of Change		
Letter of application	********	. 20
Answered ad		
Recruited		. 16
Agency		. 15
Personal approach.		
Placed ad Through contact in fire		. 12
Other		
Omer		
Dollar-Cost of Cha	000	
\$0		47
\$1-249		
\$250-499		,
\$500-999	*********	4
\$500-999 \$1,000-1,499		8
\$1,500-1,999		6
\$2,000-2,999		. 4
\$3,000-20,000		

Whichever argument is more rational, it appears that employment centers at national meetings are still a long way off. Even if members can show good cause for them, the centers would face stiff competition—both from those who feel it's none of AIChE's business, and those who have to figure out the finances without sacrificing other membership services.

Meanwhile, several suggestions from respondents to the survey deserve study. One asked that a list of companies employing chemical engineers be kept by area or state, Such a listing might be supplemented by maintaining the current job openings on this geographic basis. Because location or relocation is a big factor to many in choosing a job, and because the basic data are now on hand at AIChE headquarters, such a service might be both useful and feasible.

A second suggestion would be operative at local-section level. In a way, it supplements the previous one. Calling for better feedback on jobs available, this respondent suggests that after a member has been interviewed for a job listed in local-section files, he should submit to the section a brief resume—perhaps by postcard—of his impressions of the position. Other job-seekers might then waste less time on interviews for jobs they didn't really want.

PRI

TO

You

you ther it a

One

by 3

you

equ

rest

thes

Off

con

for

Wh

Wh

and

can

bec

val

cor

pre

CH

Finally, local sections, if they choose, can go a long way toward improving service by maintaining a two-way exchange of information between the AIChE headquarters staff man, James Buchanan, and the section. Though some already do, many others could improve these services within the framework of present policy by active employment coordination.

There is no question but that job mobility is of continuing concern to the employed engineer. Said an AIChE-member respondent: "[It] is the major bargaining point for engineers. The society should do all it can to straighten and police this area, in the interest of its membership." Said another member, more ominously, "The organized recruitment ban suggested by Deutsch & Shea] is the sort of thing that may force engineers to organize unions in self-defense."

Whatever your views as to the need for employment services, you should acquaint yourself with what is now available. Some of these have been outlined here. Other tips will be found in earlier issues of CHEMICAL ENGINEERING (e. g., Feb. 20, 1961, p. 158; Dec. 15, 1958, p. 184). If you are looking for a new job, don't let your ignorance of well-established channels make you the biggest roadblock to that job!

ONE OF A SERIES OF CHATS ABOUT THE CONSERVATION AND CONTROL OF HEAT

state.

upple-

urrent raphic relocany in e the

nd at

ervice

sible.

ld be

el. In evious dback ndent

r has

listed

l sub-

me-

im-

Other

e less they

they ward ining ation rters and eady hese k of ment

job cern

d an

[It]

for do olice

em-

ber. reby of

to

the

vou

hat

ese

ips

of

eb. p. ew of

ou

b!

NG

PREVENTION OF CRUELTY TO OLD COMPRESSORS

You've got at least one air compressor, of course. Doesn't everybody? And there it sits, pumping its heart out for you year in and year out. And you there, Simon Legree, do you ever give it a break and measure its capacity? one measure is the useful work done by your compressed air tools, of course. However, this yard stick may make your compressor installation seem way oversize, but don't blame the equipment. The puffing oldster isn't responsible for choked intake filters, poorly designed suction pipes,



overcooling, undercooling, inadequate distribution mains and wet air. All these things can cost you.

Off and on we're going to talk about on and on we're going to talk about compressors in these pages, if you don't mind. It's a big subject and the lesson for today will be confined to the air intake. Can you imagine a more logical place to start?

Where to locate the intake? Easy. where to locate the intake? Easy. Where the atmosphere is clean and cool and dry. Dirty air and grit choke filters and eventually get through to cause wear. The cooler the air, the more you can compress per revolution. You'll get 10% more air delivered at 40°F, than at 10% more air delivered at 40°F. than at 90°F. And dryness is imperative, because compressed air can't contain all the moisture it can hold in its uncompressed state. Where does the moisture go? Into mains, tools, and valves, unless it's removed. And need we add that chemical fumes cause corrosion? That includes exhaust gases from engines and furnaces. CO2 in the presence of oxygen and moisture can rust your valves, tools, nozzles and sprays. sprays.

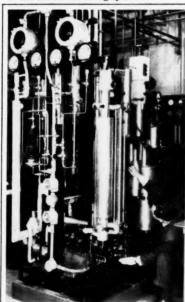
How about intake size? Keep pipes short, sized right, and straight as possible. Small pipes with snaky bends reduce pressure and capacity. For an educated example, a pressure loss due to friction in the intake pipe and filter of 2 psi (14.7 to 12.7) will reduce output of a 125 psi compressor by 7.5%. How do we know so much? Well, as we How do we know so much? Well, as v continue in future issues, we'll be talking drains and traps and cooling and safety controls for compressors—all of which we manufacture. That's how we know so much. If you can't bear to wait, just write. It's that easy to get information out of us.

SARCO AND THE **FLYING DUTCHMAN**

In the pipe shop of a major office building complex on New York's east side, the Flying Dutchman flies again. This is really a bright idea which could well become standard practice elsewhere, because it's the kind of logical precaution that would make sense anywhere.

sense anywhere.

The chap in our photograph is putting together, according to precise, dimensioned drawings, an assembly consisting of a Sarco Thermo-Dynamic Steam Trap, Type TD-50, a Sarco strainer, and valves and fittings for stock. The assemblies will be used for which are deep replacement in the stock. The assembles will be used for quick and easy replacement in the event of failure or any possible maintenance requirement in the steam distribution system, the heating system, or the air conditioning system.



WORLD'S LARGEST ESPRESSO MACHINE? WORLD'S LARGEST ESPRESSO MACHINE?
No indeedy. It's a pilot plant Hydrofiner unit built by The Lummus Company at its Engineering Development Center in Newark, New Jersey. And its presence here is due to the fifteen %" Sarco Thermo-Dynamic Steam Traps which vent and drain its 35 pound tracer lines plus a ½" TD-50 as a main drip. Nice to be picked for projects like this. Makes us proud.



We'd like to be able to report that this plan recently saved thousands of people from freezing or roasting during a crisis. So far, however, the assemblies have proved to be an ornamental kind of insurance policy. Alas, there have been no failures. That dog-goned Sarco performance is just too reliable for its own good.

WE'VE GOT THINGS TO GIVE AWAY

First of all, we have a new spring clip to hold together a bunch of papers on your desk, or something. It's not complicated, but it is difficult to complicated, but it is difficult to describe, so we've gone to the tremendous expense of having our local Michaelangelo sketch it here. If you have no papers to hold together, it makes a rather delightful snapping noise that might amuse you. Oh yes—it also has a cross section of a TD-50 steam trap printed on it which actually moves when you wiggle your eyeballs at it. In case you still don't know how a TD-50 works, this is for you.



Second, we've still got engineers' sketch pads which we enjoy giving away so much we're offering them again. In case you're new here (Helle!) they contain isometric grid paper for use by anyone involved in piping or hookup sketches for process or heating applications. heating applications.

heating applications.
And the famous Sarco key chain,
which is really exactly that—a chain—
about 60 times as handy as a fat case,
we're offering again too. This has a
TD-50 replica attached, but detachable.
Call it tawdry promotion if you will,
but our super-aesthetic wife wears
one proudly around her neck. All of these are available from your Sarco representative. Or, if he's out,

write in

There's really no reason to keep this conversation one-sided. After all, we're both interested in these subjects or you wouldn't have read this far. So write, even if it's only about a difficult problem.

SARCO COMPANY, INC., 635 MADISON AVE., NEW YORK 22, N.Y.

STEAM TRAPS . TEMPERATURE CONTROLLERS . STRAINERS . HEATING SPECIALTIES

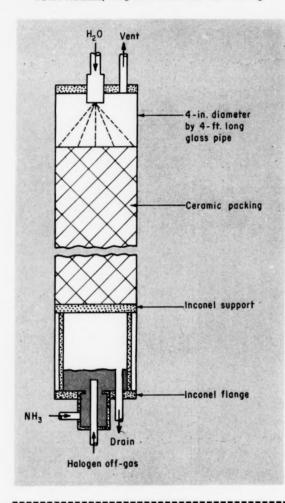


VERSATILE SCRUB TOWER REMOVES HALOGEN OFF-GASES

Off-gases react with anhydrous ammonia gas to form ammonium-halide smoke, which is dissolved and removed by water spray.

Winner of the October Contest*

JOHN HOLMES, Argonne National Laboratory



COMING JANUARY 22

A High-Precision Level Indicator

J.O. Osburn and D. L. Allen, November Contest Winners

A simple, versatile and very efficient scrub system can be constructed for the disposal of halogen or halogen-acid off-gases from small-scale pilot plants. Often these toxic and corrosive gas streams are treated in bulky and sometimes inadequate caustic scrub systems, or are released directly to the atmosphere.

The scrub system shown in the illustration has been used for the disposal of chlorine, hydrogen chloride. hydrogen fluoride and mixtures of these gases. The halogen gases react with anhydrous ammonia gas in the space below the column packing, to form a smoke of ammonium halide. Water sprayed into the top of the column dissolves the solid ammonium halide from the column walls and packing. The dual gas-inlet nozzle, which is made of Teflon, is submerged under about 1 in. of scrub solution and is, therefore, self-cleaning.

An excess of ammonia (10-25%) is used with both chlorine and hydrogen fluoride to give an ammoniacal liquid waste and thereby reduce liquid-phase corrosion. Low hydrogen-chloride flows can be scrubbed by water alone, but much higher capacity and efficiency are attained by using ammonia reactant as well.

We have also investigated the fluorine-ammonia reaction and found it to be effective for removing fluorine from the off-gas stream. But, along with soluble ammonium fluoride, highly toxic and inert nitrogen trifluoride gas is produced and presents a secondary disposal problem. We have not tested the unit with gaseous iodine, bromine or their respective acids, but such operation should be routine.

Maximum flow rates are dependent on the solubility of the ammonium halides and on the flooding characteristics of the tower. The following rates are typical but not maximum for the tower dimensions:

> 5-10 gal./hr. Water HF 10 g.-mole/hr. Cl₂ HF-Cl₂ 12 g.-mole/hr. 20 g.-mole/hr. HCl 15 g.-mole/hr.

This equipment has a much higher capacity and efficiency than the same size apparatus employing only gas-liquid caustic scrubbing because the gas-phase reaction is not limited by the usual adsorption liquidphase-reaction mechanism.

Analysis of the off-gas from the scrub tower has shown efficiency to be nearly 100% in all tests. The fact that hydrogen fluoride does not etch the glass pipe if a slight excess of ammonia is used proves that the gas-phase reaction is highly efficient.

This work was performed under the auspices of the U. S. Atomic Energy Commission.

(Plant Notebook continues on page 96)

*How Readers Can Win

\$50 Prize for a Good Idea—Until further notice, the Editors of Chemical Engineering will award \$50 each four weeks to the author of the best short article received during that period and accepted for publication in the Plant Notebook. Each period's winner will be announced in the second following issue and published in the fourth following.

nounced in the second rollowing issue and published in the fourth following.

\$100 Annual Prize—At the end of each year, the period winners will be rejudged by the editors and the year's best awarded an additional \$100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nowining articles will be published at space rates (\$10 minimum). Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant Noebook Editor, Chemical Engineering, 330 W. 42 St., New York 26.

en or PERMATU

PERMATURN VALVES • so new, we changed their colors, too. You'll find the new PERMATURN semi-steel valves bright red: a color just as bold as the design concept they represent. For Rockwell PERMATURN valves were designed to incorporate all the most-wanted valve features: to give you new valve versatility for easy services or tough ones. Steel PERMATURN valves are now gray and offer

new standards of valve performance in the higher pressure services. To learn more about this exciting new valve line, write to Rockwell Manufacturing Company, 400 N. Lexington Avenue, Pittsburgh 8, Pennsylvania for a copy of the new Pocket Valve Guide.

*Trademark Rockwell Manufacturing Company

SES

system

plants. reated b syss been loride, . The gas in smoke top of from t nozabout ning. both niacal osion. water are a refluorluble ogen dary with , but oility arac-

pical

effionly reuidhas The lass that

the

96)

yee) ate-ably win-

ING

PERMATURN VALVES

another fine product by ROCKWELL



TABLE CALCULATES CHANGE OF CONCENTRATION VS. TIME

FRANK LERMAN

U. S. Industrial Chemicals Co., Cincinnati

It is sometimes necessary to find the change in concentration of a liquid in a well-mixed vessel when there is continuous inflow of liquid at different concentration from that originally in the vessel.

By use of this table, one can readily calculate the time required for a continuous inflow of a stream of fixed concentration to change vessel concentration. Conversely, the concentration in the vessel can be found after a given inflow time.

The necessary assumptions are: (a) steady continuous inflow and outflow, (b) instantaneous perfect mixing, and (c) constant inflow concentration.

The definitions are: %C = percent change from original vessel concentration toward inflow concentration; P = number of holdup time periods to effect the change; H, holdup time, = vessel volume divided by inflow rate.

%C	P	%C	P	%C	P
99	4.605	65	1.050	30	0.357
95	2.996	60	0.916	25	0.288
90	2.303	55	0.798	20	0.223
85	1.897	50	0.693	15	0.163
80	1.609	45	0.598	10	0.105
75	1.386	40	0.511	5	0.051
70	1.204	35	0.431	1	0.010

► Example—The concentration of a component in a well-agitated, liquid-filled vessel of 48,000-gal, capacity is 0.40. At a steady continuous inflow and outflow of 6,000 gal./hr., how long will it take for the concentration in the vessel to reach 0.50, 0.60, 0.70? The inflow concentration is constant at 0.80.

The holdup time is calculated as 48,000/6,000=8 hr. The concentration 0.50 is a 25% change, 0.60 a 50% change and 0.70 a 75% change from the original vessel concentration toward the inflow concentration of 0.80.

The number of holdup time periods for these changes are, from the table, 0.288, 0.693 and 1.386, respectively. Multiplying by 8 hr. gives time to attain 25% change (0.50 concentration) as 2.3 hr.; 50% change (0.60) as 5.5 hr.; 75% change (0.70) as 11.1 hr.

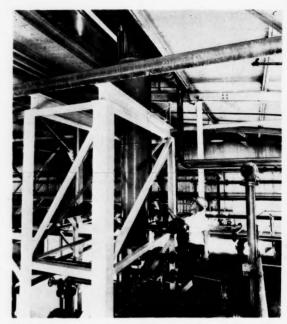
FALLING-FILM EXCHANGER ADAPTS TO ACID DILUTION

THOMAS M. GOLDMAN

Stauffer Chemical Co., Houston

We are sulfuric acid producers who find that we are doing more and more custom diluting for customers. Our previous manual batch system of mixing-off was the old method of measuring acid and water into a tank, and then pumping the dilute acid through cast-iron cooling coils. Because 78% acid was the most dilute that was produced, the coils held up well

Increasing demand, including requests for 62%



Falling-film device fits in small space over mixing tanks.

acid, led to the decision to install equipment flexible enough to handle a wide range of acid strengths on a semi-automatic basis. Our first thought was of a cascade cooler constructed of impervious graphite, a type being successfully used at one of our other plants. Discussions with National Carbon Co. engineers, however, led to the suggestion that we adapt the falling-film principle to diluting-cooling service.

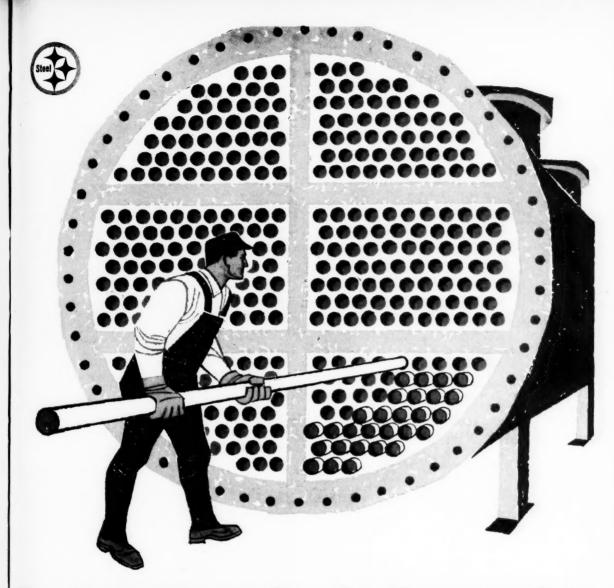
The expected advantage was elimination of feed-back of weak acid, without the need for valves. A special mixer dome had been developed for a falling-film exchanger that would assure complete mixing of separate streams of acid and water before the mixture got to the tubes. Accordingly, we purchased and installed the first such falling-film exchanger ever designed for diluting and cooling sulfuric.

A cascade unit would have required a floor area of approximately 10 x 38 ft., but the falling-film unit was installed in piggy-back fashion above our mixing tanks and uses no floor space. To achieve the desired flexibility, pipes were installed from five sources of acid supply as well as into four alternate product-storage tanks. For a simple installation, however, we estimate that, exclusive of piping, installation cost would be approximately half that of a cascade cooler of identical capacity.

Simplicity accounts for much of this saving. No concrete basin is required, no sewerage system, no headers for cooling water. Operating savings accrue from the elimination of water loss due to splash and windage, with no algae buildup to foul the equipment. The unit is also rugged, being enclosed in a steel shell.

The advantage of a cascade cooler operating under pressure and needing no pump is offset if the fallingfilm unit is installed at the point of use, with gravity

CHE



How to prevent corrosion when the pressure's on

Armco Steel Corp. #
The Babcock & Wilcox Co., Tubular Products Div. #1 The Carpenter Steel Co., Alloy Tube Div.

Jones & Laughlin Steel Corp., Electricweld Tube Div.

National Tube Div., United States Steel Corp. Ohio Seamless Tube Div., Copperweld Steel Co. Republic Steel Corp., Steel and Tubes Div. Sawhill Tubular Products, Inc. #1 Southeastern Metals Co. Southeastern Metals Co. # The Standard Tube Co. #1 Superior Tube Co. Trent Tube Co., Subs. Crucible Steel Co. of America Union Steel Corp. Van Huffel Tube Corp. Wall Tube & Metal Products Co. PRODUCES WELDED STAINLESS STEEL TUBE

S

ble on a a ts. Wıged-A gof re inle-

of nit

ng

ed

of

ct-

we

st

er

No

no

ue

nd

ıt. II. er gty

NG

PRODUCES WELDED CARBON STEEL TUBE

Hundreds of miles of welded steel tubing in various stainless analyses are being used in heat transfer equipment in the process industries ... proving its dependability.

Welded stainless steel pipe also has proved its economy and dependability. It is readily available in Schedules 40S, 10S and 5S from manufacturers stocks and local Steel Service Centers.

You can get the assurance of stainless tubing and pipe that meets high domestic standards from the quality stainless producers listed at the left. It will pay you in precision as well as in cost cutting, corrosion-killing reassurance to get information about stainless steel welded tubing from any of them. Or you can write for your free Booklet 8591 to Department CE-8, Welded Steel Tube Institute, Inc., Hanna Building, Cleveland 15, Ohio.

WELDED STEEL TUBE INSTITUTE, INC.



<u>8</u>2

flow eliminating pumping of the process streams. The unit was designed to handle 200 tons/day (100%)

The unit was designed to handle 200 tons/day (100% acid), diluting from 99% to 65%. In actual practice, it dilutes to 62% acid and every strength above that.

Acid enters at 100 F., the diluting water at 80 F., and cooling water at 90 F. and 330 gpm. Exit-acid design temperature is 130 F. Rotameter controls at ground level near the diluter-cooler regulate incoming flow rates of both acid and water. A pressure regulator has been installed in the water line, and one is under consideration for the acid line.

The unit has 85 Karbate impervious graphite tubes, 1¼-in. O.D., ¾-in. I.D. and 9-ft. long, for a total heat-transfer surface of 250 sq. ft. The tube bundle is enclosed in a 17¼-in. I.D. steel shell.

Since installation, the unit has operated almost daily without difficulty. Any overloading simply results in a higher exit temperature. A small dilute acid level is carried at the bottom of the tubes to facilitate temperature checks and sampling.

From 99% acid, we have produced 93.2, 90, 87, 78 and 62% sulfuric, and from 93.2% have produced all strengths below that. The graphite tubes handle both strong and weak acid equally well, making the unit particularly suited to our application.

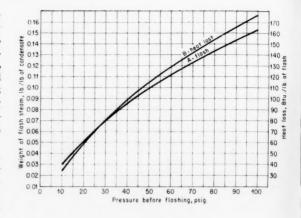
ON INCREASING ACCURACY OF PLANIMETER MEASUREMENTS

SURENDRA NATH SRIVASTAVA
Allahabad University, Allahabad, India

Measurement of the area bounded by a curve is frequently done with a planimeter. Sometimes, however, one finds that the instrument will not measure accurately enough for a specific problem. For example, assume that the planimeter has a least count of 0.01 sq. in. (6.3 sq. mm.), and it is desired to measure an area about 5 sq. mm. Clearly, the instrument is inadequate for the task.

We can overcome the difficulty by the same method that is used to measure the volume of one drop of water—measure the volume of 50 or 100 drops and divide by the appropriate number. With the planimeter, one can move the pin around the boundary ten times for a tenfold increase in accuracy. Theoretically, then, one can increase accuracy of measurement to any desired value.

A point of caution should be mentioned here, however, which limits this method. If one aims to increase accuracy 100 times or more, he will have to move the pin of the planimeter around the boundary 100 times or more. Besides being inconvenient, this procedure introduces an error in that in taking the pin around the boundary, one cannot follow it exactly. If the error is dA, then one cannot increase the accuracy beyond this figure. This sets a practical limit upon accuracy and limits also the number of rounds of the pin it is practical to take. In most cases, 10 or 20 times may be the optimum number.



FLASH STEAM DATA

EDWARD J. GIBBONS
Colgate-Palmolive Co., Jersey City, N. J.

to

af

co

To

stri

Ent

brig

ing

will

full

Write

plete

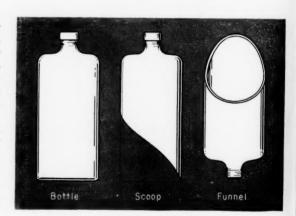
silicor Midla

CHEN

These two curves show: (A) flash steam formed per lb. of condensate (condensate collected at 1 atm. and 212 F.); (B) the heat lost in the flash steam. The curves are calculated from the following equations: Flash steam, lb./lb. of condensate =

$$\frac{h_f - 180.07}{970.3} \times \frac{1}{1 - (h_f - 180.07)/970.3}$$

Heat lost, Btu./lb. = (flash, lb.) \times 970.3 + (flash, lb.) \times 180.07.



PE BOTTLE MAKES LAB SCOOP

A. A. MACANKA
Metal and Thermit Corp., Rahway, N. J.

Recently our pilot plant found itself devoid of scoops used to charge small quantities of chemicals to reaction vessels. An emergency scoop, which served the purpose quite well, was made from a 1-qt polyethylene bottle with a capped end. The scoop can also serve as a funnel if the cap is removed.

(Plant Notebook continues on page 100)

d per

The

ions:

flash,

d of

nicals which 1-qt.

can

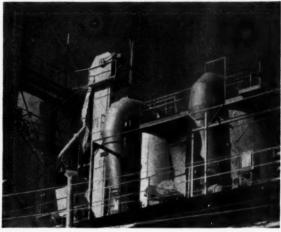
100)

ERING

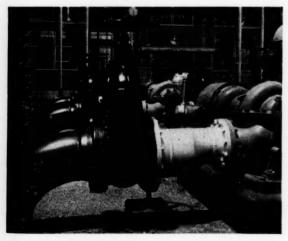
Sell silicone paint here



To resist weathering. Sun, sleet, smoke, rain ruined standard coatings within months on this water tower. But a silicone-alkyd paint is still on the job after two years; is expected to last for more years to come. Silicones helped make the sale; will help sell your paint, too. And you can cook your own vehicles with Dow Corning intermediates.



To resist heat. Surface temperatures on these kilns and stacks reach 650 to 750 F, 24 hours a day. Ordinary paints cracked, failed quickly. But a paint based on Dow Corning silicone resins has survived; prevented corrosion, saved money. Silicones helped make the sale; will help sell your paint, too. Silicone resins for every finish are available from Dow Corning.



To resist discoloration. A chemical atmosphere stripped ordinary paints, left piping ripe for rust. Enter a silicone-based paint. Surfaces have stayed bright, protected for more than three years. Repainting costs are reduced. Silicones helped make the sale; will help sell your paint, too. Write Dow Corning for full information about silicone-organic copolymers.

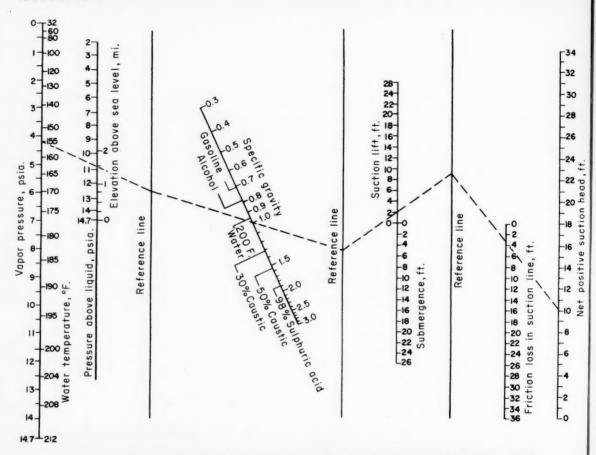


To resist corrosion. Even the best organic paints blistered, peeled within days on this bronze-melting furnace, running 10 hours a day at 650 F. But a paint based on Dow Corning silicone resins has lasted seven years with no signs of failure. Silicones helped make the sale; will help sell your paint, too. Dow Corning will help you with formulating and technical data.

Write Dow Corning Corporation for the complete story on the sales-building benefits silicones add to paints. Address Dept. 2424, Midland, Mich.



Dow Corning



NOMOGRAPH FINDS AVAILABLE NET POSITIVE SUCTION HEAD

ALAN STEVENSON

Worthington Corp., Harrison, N. J.

Proper design of a pump and piping system requires calculation of the system characteristics both at the suction and discharge ends of the pump. To avoid damage and assure good capacity with the utmost reliability, the suction side must be designed to provide adequate net positive suction head (NPSH).

This head depends on the vapor pressure of the liquid, lift or submergence of the pump, and friction losses in the suction piping. The discharge head is determined in similar manner, except that considerations other than the vapor pressure of the fluid enter into the calculation.

The nomograph provides a quick method of calculating net positive suction head from the known vapor pressure of the liquid, the atmospheric pressure (in an open system) and the suction-line pressure drop. It is based on the formula:

$$\frac{(P - P_v) 2.31}{sp. gr.} - H_f = Z = \text{available NPSH}$$

where P = pressure above the liquid, psia.; $P_* = \text{vapor}$ pressure of the liquid, psia.; sp.gr. = specific gravity of the liquid; $H_t = \text{friction}$ loss in the suction piping, ft.; Z = lift or submergence of the pump

with respect to the level of the liquid, ft.; NPSH = net positive suction head, ft.

Lift or submergence Z is measured from the pump suction centerline or centerline of the impeller to the level of the liquid. For submergence, Z is positive —for a lift, Z is negative.

► Example—Find the NPSH available in a system with 4.2-psia. vapor pressure, 10.9-psia. pressure above the liquid, 1.0 specific gravity, 2-ft. suction lift and 3-ft. friction loss in the suction piping.

Following the dashed line from left to right on the nomograph shows that the answer is 10.5 ft.

This nomograph can also be used directly when water is being pumped at a known temperature and elevation above sea level.

FILM RELEASES CONCRETE FORMS

Recently, one of the construction people at Union Carbide Corp.'s Texas City plant came up with a novel use for polyethylene film. His idea was to line the inside of concrete forms with a sheet of the film, particularly those forms used in building foundations at the plant. In use, the forms practically fall off by



34

-32

-30

-28

-26

-24

-22

Suction -18

-20

-16 16 14 12 Dositive

-io +

-8

-6

-2

SH =

pump

ler to ositive

ystem above t and ht on when e and

MS

Jnion

novel

e the par-

ns at ff by

ERING

GAR-LINE PENTON TANK LININGS

for High-Temperature Corrosion Proofing

high-temperature corrosion. GAR-LINE Penton Tank Linings are replacing and outperforming more expensive materials in an ever-increasing number of applications.

Serviceable at temperatures up to 280°F, these efficient linings embody outstanding tensile strength, excellent dimensional stability and low water absorption. Chemically, they resist bleaching agents, solvents, plating solutions ... in fact, all inorganic acids except fuming nitric and fuming sulfuric.

Can be applied to virtually any surface or contour to give superior, low cost protection against

Applied by carefully selected and authorized applicators. The experience of these tank lining experts guarantees satisfactory GAR-LINE Penton installation, prevents expensive failure due to improper application. Approved applicators include:

ABRASION & CORROSION ENGRS.

ABRASION & CORROSION ENGRS.

HANSZEN PLASTICS COMPANY
835 S. Good-Latimer Exprw.
Dallas, Texas

Dallas, Texas ATTBAR PLASTICS 1107 Northeast 106th Street Vancouver, Washington BARTHEL CHEMICAL CONST. CO., INC. P. O. Box 1025, Tacoma 1, Wash. BITTNER INDUSTRIES, INC. 91 Diaz St., P. O. Box 10265 Prichard, Alabama BUCKLEY IRON WORKS 21 Christopher St., Dorchester, Mass. BUFFALO LINING &
FABRICATING CORP.
73 Gillette Ave., Buffalo 14, N.Y.
CELLCOTE COMPANY, INC.
4832 Ridge Rd., Cleveland 9, Ohio CHEMICAL PROOF OF SEATTLE 625 Alaska Ave., Seattle, Wash. PARKER BROTHERS, INC. 7044 Bandini Blvd. Los Angeles 22, California ELCHEM ENGRG. & MFG. LTD. P. O. Box 249 Burlington, Ontario. Canada ELECTRO CHEMICAL ENGRG. & MFG. CO. 750 Broad St., Emmaus, Penn. THE FABRI-FORM COMPANY P. O. Box 125, Byesville, Ohio FLORIDA CORROSION CONTROL P. O. Box 10082, Jacksonville 7, Fla. THE FORTUNE COMPANY 1100 W. 37th St.—North Wichita 14, Kansas GALIGHER COMPANY 545 West 8th—S., Salt Lake City, Utah GATES RUBBER COMPANY Denver, Colorado GOLDEN PLASTICS CORP. 333 East 8th St., Oakland 6, Calif. GOODALL RUBBER COMPANY 2050 N. Hawthorne Avenue Melrose Park, Illinois WILLOW RUN RUBBER COMPANY 12575 Haggerty St., Bellville, Mich.

HEIL PROCESS EQUIPMENT CORP. 12901 Elmwood Ave., Cleveland 11, O. HUNTINGTON RUBBER MILLS of Port Coquitlam B.C., Canada INNER-TANK LINING CORP. 4777 Eastern Ave., Cincinnati 26, 0. MAURICE A. KNIGHT Kelly Ave., Akron 9, Ohio MERCER RUBBER CORPORATION Highway 46, Cor. Huyler Little Ferry, New Jersey METALWELD, INC. Scotts Lane & Abbottsford Rd. Philadelphia 29, Pennsylvania

PLASTIC APPLICATORS, INC. 7020 Katy Road, P. O. Box 7631 Houston 7, Texas PROTECTIVE COATINGS 1602 Birchwood Ave., Ft. Wayne, Ind. ROANOKE BELTING & RUBBER CO. P. O. Box 1593, 345 Center Ave., N.W. Roanoke 7, Virginia ROADONE /, VIIGHTA RUBBER ENGINEERING & MFG. CO. P.O. Box 2335, Salt Lake City 10, Utah RUBBER MILLERS, INC. 707 S. Caton Ave., Baltimore, Md. ST. LOUIS METALLIZING CO. 625 S. Sarah St., St. Louis 10, Mo. L. H. SHINGLE CO. 1300 Walnut St., Camden 3, N.J. STEBBINS ENGRG. & MFG. CO. Watertown, New York



specific needs, GAR-LINE* Penton** Linings can be applied to a variety of complex shapes as shown in these photos.



as the answer to your corrosion problems. For more information, contact the applicator nearest to you. Or, write for data on Penton; information also available on Teflon† linings for Anti-Stick or corrosive applications. Special Products Dept., Garlock Inc., P. O. Box 612, Camden 1, New Jersey.

*Garlock Registered Trademark
**Registered Trademark, Hercules Powder Company
†Registered Trademark, The DuPont Company

ARL

CHEMICAL ENGINEERING—December 25, 1961

themselves because they don't adhere to the concrete when the plastic film is in place.

Also, the finish on the concrete turns out much smoother than it would be with just a bare form. The forms can be used over and over, and the polyethylene holds in moisture so that the concrete will set properly. The smooth finish is also advantageous in cleaning equipment foundations.

PHYSICAL PROPERTIES OF ALLYL ALCOHOL SUMMARIZED

EDWARD M. BRAUN Middletown, Ohio

Because allyl alcohol (CH2 = CH - CH2OH or C₃H₆O) is now produced in commercial quantities for use in the resin, pharmaceutical and other industries, a compact tabular and graphical summary of its properties will be useful.

Boiling point (1 atm.)1 Coefficient of expansion (20 C.)6 Critical temperature⁵

Freezing point1

Heat of combustion³ Latent heat of vaporization⁸ at boiling point Mean specific heat of liquid, 20-90 C.¹⁰ 96.9 C.

 1.01×10^{-3} /°C. (271.9 C., 545 K. 521.4 F., 981 R. Indefinite, forms glass at -190 C.

7,620 cal./g. 163.4 cal./g. or 294.1 Btu./lb. 0.665 cal./g. °C. or Btu./lb. °F. or Btu./lb.

Molecular weight

58.08 1.4111

Refractive index, n_D^{25} , at 25 C. Specific heat of vapor

 $c_p = 0.311 + 0.000745T$ where T is °K.

Vapor pressure (mm. Hg): temperature (°C.) relationship1

0–60 C.: log
$$p=8.2946-1{,}764.4/(t+230)$$
60–120 C.: log $p=8.0986-1{,}707.4/(t+230)$ dp/dt at boiling point 27.96 mm./°C.

An aqueous solution containing 72.3% allyl alcohol by weight constitutes a constant-boiling mixture at 88.9 C. and 1 atm, pressure.

The charts show that, at 25 C., allyl alcohol has a density of 0.8476 g./ml., a viscosity of 1.20 cp., 6. 10 a vapor pressure of 23.8 mm. Hg1 and a surface tension of 25.22 dynes/cm.6

At 25 C., the viscosity of an aqueous solution that contains 30% allyl alcohol by weight is 1.74 cp.2 At 0 C., an aqueous solution of the same composition exhibits a density of 0.980 g./ml.6,7

At 10 C., the surface tension of an aqueous solution that contains 3 gram moles of allyl alcohol per 100 kg. of water is 73 dynes/cm.4

References

- References

 1. Dolliver, M. A., Gresham, T. L., Kistiakowsky, G. B., Smith, E. A. and Vaughan, W. E., J. Am. Chem. Soc., 60, 440 (1938).

 2. Dunstan, A. E., J. Chem. Soc., T, 11 (1905).

 3. Kharasch, M. S., Bur. Std. J. Res., 2, 359 (1929).

 4. Mills, H., Robinson, P. L., J. Chem. Soc., 1629 (1931).

 5. Nadejdine, A., J. Russ. Phys. Chem. Soc., 14, 538 (1882).

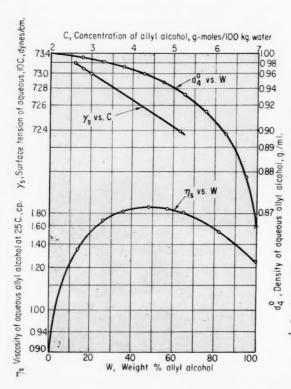
 6. Timmermans, J., Hennault-Roland, Mme., J. Chim. Phys., 29, 529 (1932).

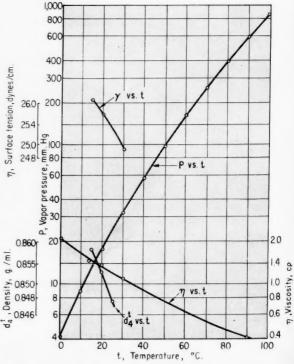
 7. Wallace, T. A., Atkins, R. G., J. Chem. Soc., 1179 (1912).

 8. International Critical Tables, 5 (1925).

 9. Landoit-Bornstein Tabellen.

 10. Lange, N. A. (ed.), "Handbook of Chemistry," 7th ed. 1,621, Handbook Publishers Inc. (1949).





Co

lat

Te

im

th

tic

co

im

Cı

ΜI

FOAMGLAS® Insulation works for GULF

EVIDENCE: Ten years ago, Gulf Oil Corporation selected FOAMGLAS Insulation for equipment at the Port Arthur, Texas, refinery. The insulation selection was important because of the high humidity in the area. The closed cellular glass structure of FOAMGLAS results in no water absorption, so GULF benefits from the same constant insulation value today as when FOAMGLAS was first installed.

745*T* ...) re-

has a consion that a that a that sition that of kg.

82). Phys., 12).

ING

Whether protecting short piping runs, tall ethylene towers or huge Hortonspheroids, FOAMGLAS Insulation insures corrosion-free operation because it stays impervious to water, vapor and acids. Be-

cause rigid FOAMGLAS can be easily cut to precise shapes, improper fitting is eliminated. And once FOAMGLAS is on the job, maintenance is kept to a minimum.

See how FOAMGLAS can solve your most severe insulation problem. Write for the Industrial Insulation Catalog: Pittsburgh Corning Corporation, Dept. CH-121, One Gateway Center, Pittsburgh 22, Pa. In Canada: 3333 Cavendish Boulevard, Montreal, Quebec.

Pittsburgh Corning makes available a complete line of accessory materials for use with FOAMGLAS Insulation. Write for Data Sheets. PITTSBURGH



No. 60: Process-Vessel Protectors

Here are costs of rupture disks, flame arrestors, vent units and dehydrators—important equipment for protecting process vessels.

BELA G. LIPTAK Instrument Engineer Crawford & Russell, Inc. Stamford, Conn.

There are a large number of devices used in the chemical process industries that fit into the category of "vessel protectors." We have collected purchase-price data on four such devices: rupture disks. flame arrestors, conservation vent units and dehydrators for storage

Rupture disks are very important and widely applied safety units used on vessels and other operating equipment for pressure relief. These disks act as weak spots in a vent line. At a preset pressure, this weak spot will rupture before the vessel becomes dangerously overstressed (see Chem. Eng., Sept. 18, 1961, p. 187). Costs of such disks are shown in Fig. 1. Usually, the disk requires vacuum support if the pressure vessel operates under vacuum. Preformed, and fitted underneath the actual disk, a vacuum support prevents disk collapse from the force of atmospheric pressure.

In many cases, metal disks are firmly gripped between a base and hold-down flanges. Costs are shown

Graphite disks, shown in Fig. 3, are used at low preset pressures and in corrosive service. Such disks are directly mounted between flanges and do not require a base

Flame Arrestors, Dehydrators

Why

they

does

was

liner

amo

dimi

the 1

was

gists

Bi

ch

De

Сн

Aluminum, stainless in Fig. 2. or copper disk

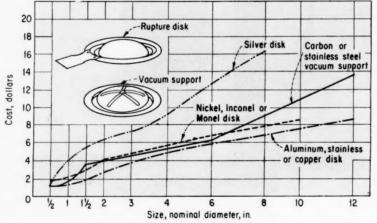
and hold-down flanges.

Flame arrestors are used on tanks holding volatile and flamliquids. Gases passing through the breather vents, if ignited, cannot flash back into the Flame arrestors contain "banks" consisting of flat and corrugated sheets arranged alternately so there is a vertical passage through the arrestor. Banks are deep enough so there is no burning through to the tank contents. See Fig. 4 for cost data.

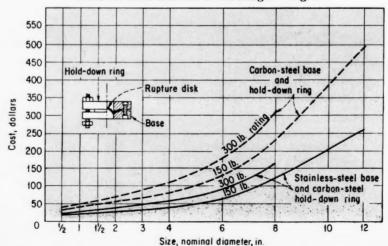
On outdoor installations, flame arrestors are furnished with weather

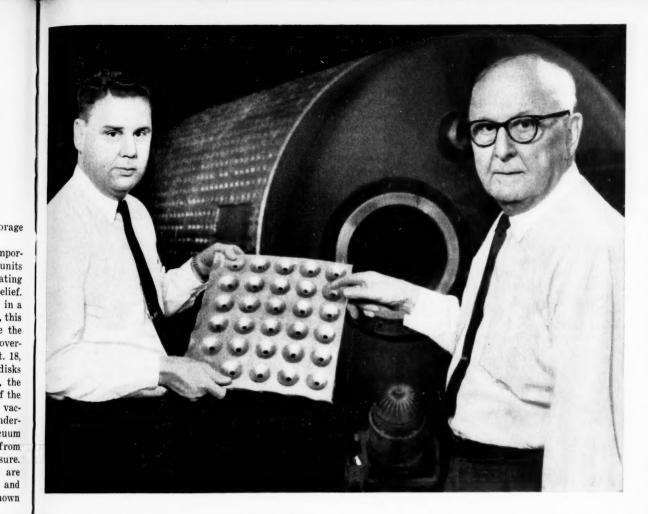






Costs for base and hold-down flanges—Fig. 2





"This Dimple Jacket Construction saves customers plenty!"

Paul Hock, President, Alvin I. Hock, Board Chairman, Brighton Corporation

Why? Because it's costing them 20 to 30% less than they've been paying for conventional reactors and it does a better job. Where formerly heavy gauge stainless was used to form the jacket and thick plate for the tank liner, light gauge was substituted. To gain the same amount of resistance to pressure, the stainless steel was dimpled. The jacket was then formed and placed on the kettle by our special welding method. This method was evolved after extensive research by our metallurgists and at the present time, is a special process ex-

clusive with Brighton. While the jacket is ASME approved to 162 p.s.i., exhaustive tests have shown it to withstand bursting pressures up to 1000 p.s.i.

Write for Bulletin No.BF-6, or send your specifications for a prompt quotation to Dept. A-12.



BRIGHTON CORPORATION

CINCINNATI 4, OHIO

Brighton Dimple Jacketed Tanks are built for these industries:

chemical petrochemical petroleum explosives

beverage

g. 3, ures lisks

veen base

rs

on

am-

sing

if

the

tain

cor-

tely

age

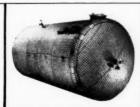
are ing See

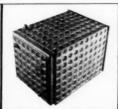
arher

hor. 137 File itrol

ING

pharmaceutical paint and varnish distilling and wine making paper and paperboard Jood processing







hoods (see Fig. 4). The opening on the hood has a mesh wire screen to prevent large, wind-blown, particles from getting into the flame arrestor.

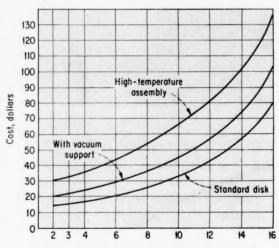
As an example of how to use Fig. 4: What is cost of 3-in. flanged flame arrestor, carbon-steel body, stainless-steel bank material, semi-steel weatherhood? From curve, arrestor is \$195; multiplier is 1.15, weatherhood is \$25. Total is \$250.

Conservation vent units (Fig. 5) control tank breathing. They prevent free escape of vapors and also protect the tank contents from the possibility of fire entering the tank through a vent pipe.

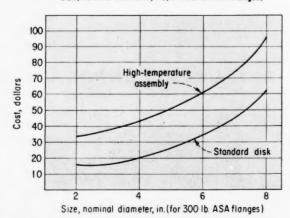
Dehydrators (Fig. 6) remove moisture from any air entering storage tanks. They are particularly useful when a product is being removed from a tank—wet air coming in through a vent line during this operation could dilute or contaminate the tank contents. The unit on which the cost data of Fig. 6 are based consists of a bed of activated alumina, held in a wire basket; all in a gas-tight housing.

Costs refer to first-quarter, 1961.

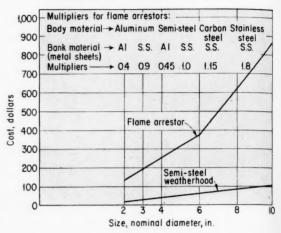
Graphite disks for corrosive service—Fig. 3



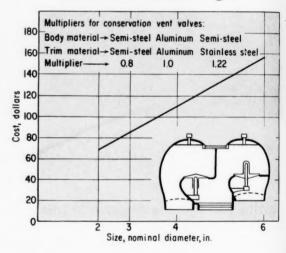
Size, nominal diameter, in. (for 150 lb. ASA flanges)



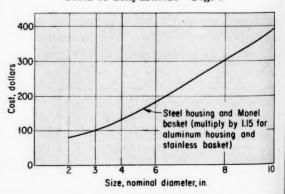
Flanged flame arrestors—Fig. 4

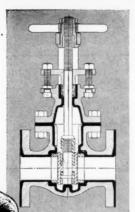


Conservation vent units-Fig. 5



Costs of dehydrators-Fig. 6





Darling rubber-lined (heavy lines) iron body gate valves with special alloy working parts provide trouble-free operation in many corrosive and abrasive services.

YOU CAN DEPEND ON

Darling rubber-lined iron body gate valves eliminate the need for expensive special alloy valves in many different applications.

The hard rubber lining on bodies and bonnets provides high resistance to corrosion and abrasion in services up to 180° F. and working pressures up to 150 lbs. The revolving double disc parallel seat and wedge construction minimizes friction, avoids wear concentrations, and automatically compensates for any valve seat deflection. You can depend on Darling rubber-lined iron body gate valves for maximum efficiency at minimum cost.

Darling rubber-lined iron body gate valves in rising stem, cylinder or motor operated, and quick-opening types, as well as rubber-lined iron body check valves, are available in sizes from 2" to 24". Write, wire or phone for bulletins.

DARLING VALVE & MANUFACTURING COMPANY

Williamsport 3, Pa.

Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario, Canada Vannes Darling-France, 23 rue du Commandant Mouchotte, St. Mandé, France

GATE . BUTTERFLY . CHECK . SPECIAL VALVES . FIRE HYDRANTS

for

RING

DARLING



Convair (Astronautics)

Steel Tanks For Rocket Fuels

Here's basic information on using precipitation-hardening stainless steels to hold exotic fuels and oxidizers.

JOHN HALBIG, Armco Steel Corp.

Precipitation-hardening stainless steels offer a combination of corrosion resistance and high strength, over a wide temperature range, that is becoming increasingly attractive to engineers designing rocket-propellant holding and handling devices.

During initial materials-selection work, the specifics of corrosion resistance often assume paramount importance when rocket fuels and oxidizers are involved.

The following discussion presents pertinent liquid rocket-propellant corrosion data for 17-4 PH, 17-7 PH and PH 15-7Mo stainless steels. Armco 17-4 PH and 17-7 PH were the first of the precipitation-hardening stainless steels and were closely followed by PH 15-7Mo. These materials have been widely used in missile, aircraft and industrial applications.

However, information in the specialized area of rocket-fuel corrosion rates has not been readily available from one source, although information on mechanical properties and data on corrosion resistance in common media have been readily available for some time.²⁻⁴ Most data reported here have been

developed by propellant producers or by other research agencies.

A particularly well-known source that has been utilized is DMIC (Defense Metals Information Center) Memorandum No. 65, prepared by Battelle Memorial Institute.

The steels covered are 17-4 PH, 17-7 PH, PH 15-7Mo; the constituents of these steels are shown in the table on the next page.

Precipitation-hardening stainless steels are used for tanks, thrust chambers, fins, fuel-line elements, control shafts, and related components for various fuels and oxidizers. These include oxygen, hydrogen, nitrogen tetroxide, red and white fuming nitric acid, anhydrous ammonia, hydrogen peroxide, hydrazine and unsymmetrical dimethyl hydrazine (UDMH). Except for long-time retention of hydrogen peroxide, discussed later, these precipitation-hardening stainless steel alloys are suitable for storage as well as short-time usage.

In most chemical media, corrosion resistance of the above stainless steels will generally be equal to or somewhat lower than that of standard chromium-nickel grades. Corrosion resistance is considerably better than that of the standard hardenable grades. However, as in all types of corrosion, rates will be greatly affected by temperature, concentration of solutions, contaminants, surface conditions and other factors.

► Hydrogen Peroxide — With hydrogen peroxide, the major consideration is decomposition rate rather than possible corrosive effects on stainless steel. Surface contamination accelerates the rate of peroxide decomposition.

In one report (dated 11 years ago), it was stated that 17-4 PH (heat treatment not indicated) had a corrosion rate of 0.4 mils/yr. in 90% hydrogen peroxide, based on a 1-wk. test.⁵ It is particularly interesting that no catalytic decomposition occurred during the first two days. Thereafter, a very slow

There is no point in buying a "good" valve and then paying to replace it over and over again. This kind of valve maintenance not only costs man hours; it costs even more in process down time. You can put a Durco SLEEVELINE® valve in your line and forget it.

Long service life. The large sealing area of the Teflon* sleeve will withstand erosion, nicks, scoring and general wear

for years in process liquids, gases or slurries without leakage. Plugs and bodies are available in the right Durco alloys to withstand



specific corrosive conditions. In fact, some of the first Sleeveline valves sold over ten years ago are still in service in many of these applications.

No lubrication. A Teflon sleeve surrounds the plug. Teflon's resiliency and low coefficient of friction seal tight, yet permit the plug to turn without backbreaking effort.



Simple adjustment for wear. The thickness of the Teflon sleeve allows for up to 1/4" of vertical adjustment for wear before sleeve replacement becomes necessary.

No machining or replacement parts. When wear or damage require replacement of a sleeve or plug there is absolutely no machining or fitting. No disc assemblies have to be reground or fitted, no plugs have to be lapped. New Durco plugs will seal in old sleeves—new Durco sleeves will seal around old plugs. There is complete interchangeability of new and old parts in any Durco valve of a given size.

DU PONT REGISTERED TRADEMARK



THE DURIRON COMPANY, INC.

Serves the process industries

YOU DON'T HAVE DURGO

oducers

C (Delenter) red by

4 PH.

nstituin the ainless thrust

ments, compod oxin, hyed and

drous e, hyl di-Exon of

later, staine for isage. corrostain-

equal at of ades. rably idard as in

ill be ture, tamother

hynsidther s on nina-

ears
PH

had in n a in-

omfirst

RING

323

2

ΜI

Chemical analyses of Armco precipitation—hardening stainless steels

	PH 15-7Mo	17-7 PH	17-4 PH
Carbon	0.09 Max.	0.09 Max.	0.07 Max.
Manganese	1.00 Max.	1.00 Max.	1.00 Max.
Phosphorus	0.04 Max.	0.04 Max.	0.04 Max.
Sulfur	0.04 Max.	0.04 Max.	0.03 Max.
Silicon	1.00 Max.	1.00 Max.	1.00 Max.
Chromium	14.00-16.00	16.00-18.00	15.50-17.50
Nickel	6.50-7.75	6.50-7.75	3.00-5.00
Molybdenum	2.00-3.00		
Aluminum	0.75-1.50	0.75-1.50	
Copper			3.00-5.00
Columbium and tantalum			0.15-0.45

evolution of bubbles began, but did not increase in intensity. No data are given on the temperature or the peroxide strength at the end of the week-long period.

There has been apprehension about the use of 17-4 PH in hydrogen peroxide because of the presence of copper in this alloy. This is not a valid objection, as the copper is not present in the alloy as free copper but is completely tied up with other alloying elements so that it will not affect the $H_{\nu}O_{\nu}$.

This is confirmed by the complete absence of attack on 17-4 PH after a 2,260-hr. test involving sodium acetylide sludge, which is highly corrosive to copper.

The Battelle work provides more information on hydrogen peroxide and the precipitation-hardening types of stainless. Battelle uses several rating systems for materials in rocket-propellant service. One, for example, takes into account corrosion rate, decomposition and impact sensitivity.

Hydrogen peroxide is difficult to classify for construction materials. Decomposition effects are of primary concern and the rating system differs. In this and other sections that follow, the terms Class 1, 2, 3 or 4 do not necessarily mean the same thing. In each instance where such rating is given, its meaning in that instance is also given.

DMIC[®] places 17-7 PH of 37-45 Rockwell "C" hardness, and unhardened 17-7 PH, in the Class 2 category for 90% H₂O₂ service. This means that for this propellant the maximum active oxygen loss by the H₂O₂ in one week, at 30 C., is 6%; at 66 C., the maximum loss in one

week is 80%. There is no other effect on the H_2O_2 .

No corrosion of the 17-7 PH itself occurs, although a slight bronzing of the metal is considered permissible. Buffed 17-7 PH, Rockwell C45, is placed in this same category.

In Class 3, DMIC has placed electropolished and pickled 17-7 PH (Rockwell C45) and 17-4 PH (hardness not indicated). For Class 3 materials, the maximum active oxygen loss by H_2O_2 in one week at 30 C. is 11%; at 66 C., the maximum loss is 100% in 24 hr. Under this rating, bronzing and staining but no rust or other corrosive products are permitted. Slight attack is allowed, however.

In general, the 17-7 PH type of stainless steel is satisfactory, but the 400-series steels are not. A 120-grit finish on the 17-7 PH steel improves service.

One means of reducing decomposition is passivation. After cleaning with appropriate solvents and rinsing with tap water, the 17-7 PH steel is treated with a 2% Na₂Cr₂O₇ • $2H_2O$ —20% HNO₃ solution for $\frac{1}{2}$ -hr. at 120-130 F., followed by conditioning in the concentration of H_2O_2 that the alloy will be required to handle.

A typical application of a precipitation-hardening stainless steel with the propellant is the use of 17-7 PH for valve stems in control valves for the *Freedom VII* capsule that lofted the first U.S. astronaut.

The only corrosion problem encountered in early tests was accelerated corrosion of a cast-aluminum valve body. (The proximity of the aluminum and the 17-7 PH actually benefited the stainless at the

sacrifice of the aluminum casting.) The problem was solved by coating with Teflon that portion of the valve stem in contact with the aluminum. ► Ethylene Oxide—17-4 PH, 17-7 PH and PH 15-7Mo do not promote polymerization of ethylene oxide. The maximum corrosion rate determined from weight loss after two weeks in commercial distilled ethylene oxide at 257 F. was 0.06 mils/vr. or less. 17-4 PH (condition H900) and 17-7 PH (conditions RH1005 and TH 1050) are more resistant to pitting in this medium than PH 15-7Mo and Type 304 stainless, but pitting can occur.

▶ Hydrazine—In several processes for the manufacture of hydrazines, sodium hypochlorite and other chlorine-containing compounds are used. As a result, commercial hydrazines may have some chloride ions present. In appreciable amounts, these ions conceivably could lead to corrosion in the presence of water. This point should be recognized.

Hydrazine compatibility with various metals depends on the corrosion behavior of the material on the one hand and the effect of the material and corrosion products on the rate of hydrazine decomposition on the other.

DMIC⁶, in its compatibility survey of various materials, lists 17-7 PH stainless steel in Class 3 for applications at 160 F. For Class 3 materials, corrosion rates of 5 to 50 mils/yr, are permitted. The material may cause moderate breakdown of the propellant, but it is not shock-sensitive under conditions likely to be found in service.

In general, stainless steels containing more than 0.5% by weight molybdenum and copper should be avoided, especially at temperatures above 100 F. Since 17-4 PH and PH 15-7Mo contain more copper or molybdenum than this, their use in this medium must be considered with caution. Testing under simulated operating conditions is indicated.

▶ Dimethyl Hydrazine — The hydrazine derivative, unsymmetrical dimethyl hydrazine (UDMH), affects materials in much the same manner as hydrazine. Of the metals, low-alloy steels, aluminum, and

n rate

al hyloride iable vably presald be varcoral on

sition sur-17-7 3 for ass 3 5 to ma-

reaks not tions con-

ures and er or use ered

hyrical afame

tals, and

RING

after stilled

s 0.06 condilitions ore reedium e 304 ur.

cesses zines, other s are

f the

eight d be

imu-

sting.) oating e valve ninum. , 17-7 t prohylene

ts on

indi-



hy experiment? 221 million square feet of steel

en protected by

is equivalent to coating...

25,398 miles of 6 in. pipe . . . enough to encircle the earth.



The weather decks of 5,973 T-2 tankers.



The cargo tanks of 701 T-2 tankers.



The shells of 17,588

floating roof tanks

(55,000 bbl.).

The hull exteriors of 3,252 T-2 tankers.

When Dimetcote was introduced in the United States from Australia in 1950 the idea that a single coat of "paint" could resist weathering, salt spray, petroleum products and severe abrasion for 10 years seemed incredible. Actually there are today many Dimetcote installations which have been in service for over 20 years without maintenance.

The success of Dimetcote has literally forced a revolution in the paint industry. Most major paint manufacturers are working to develop "something like Dimetcote" to fill the breach. Some of these products may eventually approach Dimetcote's performance, but this will not be known for several years.

Short-term tests of inorganic zinc coatings are meaningless. Repeated Florida tests for weathering and sea water immersion (constant and intermittent) prove this. Some of the new zinc coatings perform well for 18 to 30 months, then suddenly break down completely, allowing general rusting and pitting of the underlying metal.



The decks of 28,333 floating roof tanks (55,000 bbl.).

So don't be misled. All zine coatings are not the same. Only Dimetcote gives you time-tested performance, not "long life" projections based on short-term tests. Since Dimetcote costs no more per mil square foot than the unproven products . . . why experiment?

Write for complete technical data:



Dept. A-Y, 4809 Firestone Blvd., South Gate, Calif.

2404 Dennis Street Jacksonville, Florida 921 Pitner Avenue Evanston, Illinois

111 Colgate Avenue Buffalo 20, New York 360 Carnegie Avenue Kenilworth, New Jersey

6801 Silsbee Street Houston, Texas

stainless steels are commonly used to contain UDMH. Due to the greater stability of UDMH, DMIC has placed 17-7 PH (hardness not stated) in Class I, the completely compatible category, up to 160 F. Derr and Raleigh⁸ show rates of less than 0.1 mils/yr. for PH 15-7Mo and 17-7 PH (conditions not indicated) in 28 days at 86 F. and less than 0.1 mils/yr. for 17-7 PH at 146 F. for 7 days. No change was observed in the UDMH stability.

Derr and Raleigh,8 in a discussion appended to their paper, concluded that UDMH was much less sensitive to decomposition by oxides of molybdenum and copper than hydrazine. As their tests were of very short duration (5 min.), they did not know what effect these oxides might have on UMDH decomposition after long-time exposure. They reported more-extensive tests, involving copper and molybdenum, were in progress.

► Oxygen—While oxygen is highly reactive chemically, liquid oxygen is noncorrosive to most metals. In particular, the precipitation-hardening stainless steels hold up well.

► Ammonia—All three grades of precipitation-hardening stainless steels-17-4 PH, 17-7 PH and PH 15-7 Mo-are considered satisfactory for handling ammonia. The 17-4 PH grade, containing some copper, is not adversely affected by cracking as are standard copper alloys. Generally, temperature limits for these steels in ammonia service are high. (The upper-temperature limit is actually the nitriding temperature.)

While air as a contaminant is believed to lead to cracking in highstrength nonstainless steel ammonia-storage tanks, no data are available on these precipitationhardening alloys in this regard.

► Hydrogen—Liquid hydrogen and gaseous hydrogen at low temperatures are both considered to be noncorrosive.6 Low-temperature embrittlement is more important.

► Nitrogen Tetroxide — In static tests with 3.2% by weight water from 3 to 27 days, PH 15-7 Mo (condition RH950) has shown very low corrosion rates up to 74 C. Under circulating conditions at 26 to

31 C. for 101 and 104 hr. of test, PH 15-7 Mo (condition RH950) has shown no corrosion.9

▶ Fuming Nitric Acids—The fuming nitric acids used in propelling systems are very corrosive to met-Red fuming nitric acid (RFNA) may contain up to about 30% nitrogen dioxide and about 2-3% water. White fuming nitric acid (WFNA) may contain as much as 2% nitrogen dioxide and 2%, or less, water.6, 10

Neither red nor white fuming nitric acid has much in common with 65% boiling nitric acid.10 The corrosion behaviors, in particular, are of a different magnitude.

Fontana11 reports rates for austenitic stainless steels in white fuming nitric acid at 122 F., slightly lower than in the red acid. These rates vary between 12 to 70 mils/ yr., depending on the type of stainless steel. At 160 F., the rate increased roughly four- to five-fold.

Other data indicated that 17-7 PH (condition TH 950) has a very low corrosion rate in WFNA, about 1 mil/yr. at room temperature, but a very high rate of about 300 mils/ yr. at 160 F.

Also, 17-7 PH (condition TH 1050) is less resistant to the corrosive action of red fuming nitric acid than types 304 and 347,12 corroding at a rate of 250 to 300 mils/ yr. at 120 F. At 160 F., 17-7 PH corrodes at a still higher rate. (These rates are based on tests that ran 30 days or less.)

Phelps, Lee and Robinson13 discuss in detail the effectiveness of hydrofluoric acid as an inhibitor of corrosion of 17-7 PH by red fuming nitric acid that contains 12% NO at 120 and 160 F. The addition of 0.75% hydrofluoric acid reduced the 120 F. corrosion rate to 1.7 mils/yr. in the liquid phase and 0.16 mils/yr. in the vapor phase. Effective inhibition also occurred at 160 F. Thus, 17-7 PH is highly satisfactory when hydrofluoric acid can be used in red fuming nitric acid.

The Battelle DMIC report⁶ places hardened 17-7 PH (aging treatment not indicated) in Class 2 at 130 F. for inhibited RFNA containing $0.6\pm~0.1\%$ HF as the inhibitor. This class indicates that a corrosion rate as high as 5 mils/ yr. is permitted, with no decomposition or impact sensitivity. Mason and his associates14 found a marked reduction in corrosion of 17-7 PH (condition TH 1050) at 130 F. with an addition of about 0.5% by weight hydrofluoric acid in fuming nitric acid.

References

1. Marshall, M. W., others, Metal Progress, 70, No. 1, 94-98 (1956).
2. Halbig, J., Ellis, O. B., Corrosion, 14, No. 8, 38y1-395t (1958).
3. Marshall, M. W., Tanczyn, H., Metal Progress, 75, No. 3, 121-125 (1959).
4. Applications Bulletin, "Armoo Precipitation Hardening Stainless Steels—Missile Applications," Armoo Steel Corp., Dec. 1, 1960.
5. Huston, K. M., private communication, Apr. 4, 1950.
6. Boyd, W. K., White, E. L., DMC Memorandum 65, "Comptability of Rocket Propellants with Materials of Construction," Battelle Memorial Institute, Sept. 15, 1960.

15, 1960.
7. Huston, K. M., private communication, Dec. 30, 1958.
8. Raleigh, C. W., Derr, P. F., Corrosion, 16, No. 10, 507t-511t (1960).
9. Alley, C. W., others, Corrosion, 17, No. 10, 479t-484t (1961).
10. Clark, J. D., Walsh, M. E., Transactions of the New York Academy of Sciences, Series II, 17, No. 4, 279 (1955).
11. Fontana, M. G., Reports of the Ohio State University Research Foundation (1951).

State University Research Foundation (1951). 12. Srp., O. O., private communication, Aug. 3, 1956. 13. Phelps, E. H., others, WADC Tech-nical Report 55-109 (1955). 14. Mason, D. M., others, Corrosion, 13, No. 12, 821t-827t (1957).

Meet the Author



JOHN HALBIG is a senior research engineer engaged in corrosion work at the research center of Armco Steel Corp., in Middletown, Ohio.

He has a B.E. in chemical engineering from Johns Hopkins University, and is a member of the National Assn. of Corrosion Engineers (NACE), American Society for Metals (ASM) and the Technical Assn. of the Pulp and Paper Industry (TAPPI).

...to your order

mils/ ompo-Iason arked 7 PH

0 F.

% by

ming

Prog-

n, 14,

Metal Preeels— Corp.,

inica-

DMIC locket struc-Sept.

Cori, 17,
ransy of 955).
Ohio ation
ation,
rechi, 13,

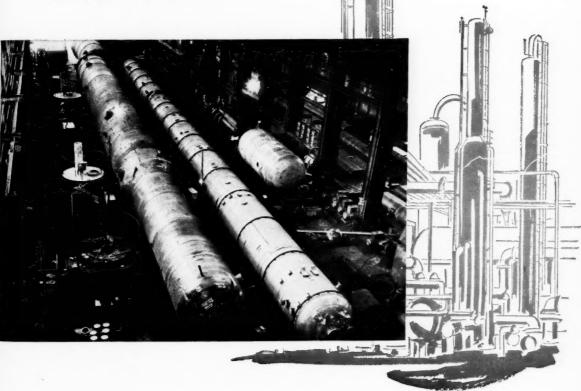
eersity,
ssn.
EE),
VED,

ING

Debutinizers, exchangers, fractionating towers, pressure vessels or intricate processing equipment—you name it; we'll build it—to your requirements with exact precision. The size or shape is limited only by the customer's desire. Delivery on schedule is no problem by rail or water from our tidewater plant.

For forty years engineering leaders in the oil refining and chemical industries have been calling upon Sun Ship for important components for the building of large plants.

Let Sun Ship help solve your machine and equipment problem. Phone or write our Sales Engineering Department.



Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE • SINCE 1916 • CHESTER, PA.

. . . one of a series presented by Western Supply Company, Tulsa, to improve the "I. Q."* of engineers . . . (""Income Quotient")

TRAIN YOURSELF AND OTHERS IN SUPERVISORY TECHNIQUES FOR PROFESSIONAL ADVANCEMENT

Popular thinking on any subject is often like a pendulum, swinging forward in sheer exhilaration over an exciting idea, then backward to a cynical attitude against it. Years ago, health columnists extolled the nutritive qualities of spinach. Shortly thereafter, it was equally popular to decry spinach as an over-glamorized weed.

This vacillation springs from the efforts of spokesmen to capture interest, and the tendency of many people, like wild creatures in the forest, to give attention to whatever is moving regardless of the direction. That is why it sometimes seems that the more preposterous an idea the more credence it receives.

After World War II, supervisor and management development became extremely popular. Some of these programs naturally fell short of expectations, and there are always detractors — ready to display their intellectual brilliance by speaking cynically of all types of human relations training. Real progress in supervisory methods has, therefore, been slow.

Supervisory personnel, continually aware of the intrinsic values of human relations, are the key to uninterrupted production, completion of projects successfully and on time, for they forge the links in the productive chain solidly together.

Your management is interested not only in the creative, bold steps you would take into unknown solutions to problems, but also in how quickly and productively (profitably) you can put these ideas into practical application. When the solution, or idea, leaves your desk and starts down the long line of being put into practice, the supervisors throughout that chain of action will determine to a great extent whether their individual components will function properly or whether a project will bog down under the weight of misunderstanding and apathy.

It is extremely important, therefore, to maintain good supervisory practices throughout the various departments through which the original concept must be translated. It means a thorough understanding of human relations yourself, and the ability to communicate this understanding and appreciation to the supervisory personnel under you. This can and probably must be done both by individual contact with your supervisors and/or by conducting actual courses of

and/or by conducting actual courses of study on the subject.
FOOTNOTE: the foregoing paragraphs are a direct quotation from another of Western's 'personal-professional development' series, Booklet E-7, titled "Supervision — for Professional Advancement' a copy of which is yours upon request, without obligation. Write to WESTERN SUPPLY COMPANY, HEAT EXCHANGER DIVISION, P. O. Box 1888, Tulsa, Okla. — where supervision contributes greatly to the manufacture of heat exchangers of the highest quality, and where personal attention to detail is our watchword.

CPI NEWS BRIEFS . . .

Continued from page 40

gal./day of butane, 8,500 gal./day of natural gasoline. Tidewater will operate the unit, but share ownership with Tenneco Oil Co., Lone Star Producing Co., Edwin M. Jones Co. and others.

Du Pont plans to expand p-nitrochlorobenzene, p-nitrophenol, and p-nitrosodium phenolate capacities at its Chambers Works in Deepwater Point, N. J. Production of p-nitrochlorobenzene, which has been doubled in the past year alone, will be hiked to "several" million lb./yr. by late 1962. Additional capacity for p-nitrophenol and p-nitrosodium phenolate, both derivatives of p-nitrochlorobenzene, is expected to come on stream by mid-1962.

Air Products and Chemicals, Inc., has brought a \$10-million oxygen plant on stream in Cleveland. Products: 600 tons/day of liquid and gaseous oxygen, nitrogen, argon and neon. One of five tonnage oxygen plants placed in operation this year by the firm, unit will pipe most of its gaseous oxygen output directly to Jones & Laughlin Steel Corp.'s basic-oxygen steelmaking furnaces.



Westinghouse Electric Corp.'s seawater desalting plant at Point Loma, Calif., is under construction. Being built by Westinghouse under Dept. of the Interior's demonstration desalting program, unit will use multistage flash evaporation to produce 1 million gal./day of fresh

water for nearby San Diego residents. In the 10 evaporator vessels to the left (above), brine is routed through 36 flash-evaporation steps.

Wyandotte Chemicals Corp. has awarded Fluor-Singmaster & Breyer, Inc., a contract to design and construct a propylene oxide plant at Wyandotte, Mich. Construction will begin soon, with completion scheduled for next July. Neither cost nor capacity of the project has been disclosed.

Koppers Co. plans to boost capacity by 25-30% at its Follansbee, W. Va., coal chemicals plant. Due completed in February, expansion will increase capacity for xylols and such tar acids as phenols, cresols and cresylic acids.

Companies

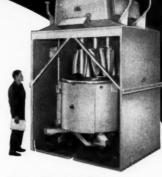
The Glidden Co., Cleveland, and Pemco Corp., Baltimore, have merged. A producer of porcelain enamel, ceramic frits and inorganic colors, Pemco will be operated as part of Glidden's Chemicals Group. Under the terms of the merger, Glidden exchanged 199,840 shares of a new cumulative preferred stock issue for the 99,920 outstanding shares of Pemco common, a consideration of about \$10 million.

Humble Oil & Refining Co., Houston, and Olin Oil and Gas Corp., New Orleans, have reached "tentative agreement" on a plan by which Humble would acquire Olin for an estimated \$68 million in stock. "Early" next year, Olin's 2,830,000 outstanding shares of common stock would be exchanged for an undisclosed number of shares in Humble's parent company, Standard Oil Co. (N. J.), in a tax-free exchange that must be approved by the government as well as Olin shareholders.

Cities Service Co., New York, has agreed to acquire Fairway Oil and Gas Co., Tyler, Tex. By the move, Cities Service would get Fairway

Day Titan Mixers

Unsurpassed for processing solid rocket propellants and other materials requiring precision mixing.



Day Regal Mixers

Unique agitator action reduces mixing time as much as 50% over other methods. Change cans keep down-time to a minimum.



esisels ted eps. has &

ign

ride

onomuly. the

ac-

ee.)ue ion ols ols,

nd

ve ain

orer-

m-

of

ed

lahe

of of

IS-

p.,

a-

by

in

in

's

of

ed

of

n-

in be

as

as ıd

e, ıy

G

Daysolvers

Multiaction turbopeller combines five different mixing actions in one for the most efficient product dispersion.



Day Pony Mixers

The recognized standard of the process industries for efficient change-can mixing of granulations, pastes, and liquids.



Day 3-Roll Mills

Produce dispersions of the highest possible quality of all types of printing inks, plastisols, paints, ointments, and similar materials.



Day Ro-Ball Sifters

To Process at a Profit

UY DAY.

Gyrating screens bring every particle of material, wet or dry, into contact with the screen. Superactive ball-cleaning action provides fast, accurate sifting. Available in single and multiple screen models.



Day Nauta Mixers

less power than conventional mixers. Mias fats and oils to mix without the formation

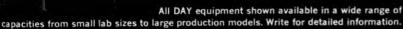


Day Ribbon Blenders

Available in light, medium and heavy-duty models for fast, economical mixing of powders, pastes and liquids.



Day Hy-R-Speed Mills Grind, homogenize and blend all types of materials, flowing or paste, in one operation.



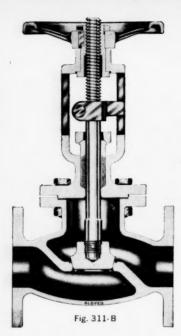
Licensees for manufacture and sale of Day Processing Equipment with the exception of the Nauta mixer. W. J. Jenkins & Co., Ltd., Retford Nots, England—representatives for the Free Trade Area: Mauri Bros. & Thompson, Ltd., Sydney, N.S.W., Australia, for Australia and New Zealand.

The J. H. DAY Co.

Division of The Cleveland Automatic Machine Co.

4926 Beech Street, Cincinnati 12, Ohio





7 ADVANTAGES OF THE NEW ALOYCO GLOBE VALVE DESIGN!

Redesign of sizes 2 inches and larger involves conversion from a rotating stem with rising handwheel and free floating disc to a non-rotating stem, non-rising handwheel with disc assembly pinned to the stem. Advantages include:

- No spiral wear pattern on stem from hardened packing or hard deposit in stuffing box.
- Rapid visual check of throttling control by observing location of stem stop.
 No galling of back seat because of ro-
- tating stem.
- No galling between seat and disc.
- Stronger disc to stem connection.
- No spinning of disc.
- Less corrosion attack because of elimination of cavity between stem and disc.

For more information on these Aloyco valves of Stainless Steel and other corrosion resistant alloys, write for Bulletin #7, Alloy Steel Products Company, Inc., 1301 West Elizabeth Avenue, Linden, New Jersey.





ALLOY STEEL PRODUCTS COMPANY

CPI NEWS BRIEFS . . .

Oil's 30% interest in leases covering about 7,000 acres of the rich Fairway field in Anderson and Henderson Counties, Tex. Cities Service Co.'s principal producing subsidiary, Cities Service Petroleum Co., Bartlesville, Okla., already holds a "substantial" interest in the gas field, will be operating approximately 40% of the field's known acreage when the acquisition of Fairway Oil is consummated.

Jupiter Oils Ltd., Chicago, and Commonwealth Oil Co., Houston, have agreed to merge. New firm would be named The Jupiter Corp., a Delaware corporation, which would issue shares of a new preferred stock issue to Commonwealth shareholders. Jupiter Oils Ltd. is a diversified venture that currently operates in three areas: hotels and motels, printing, and oil and gas. Commonwealth Oil Co. operates an offshore gas-gathering system off the coast of Vermilion Parish. La.

International

Israel: Electrochemicals Industries (Frutarom) Ltd., Acre, has signed an agreement with Monsanto Chemical Co. under which the latter will provide the knowhow for a \$3-million polyvinyl chloride plant to be built at Haifa. Initial capacity will be 10-12 tons/day, ultimately to be hiked to 20 tons/day. Production is expected to begin in 1963. Electrochemicals Industries will create a subsidiary, Electrochemical Plastics Industries Ltd., to operate the PVC facility.

Spain: Centrales Nucleares S.A. (CENUSA) has been approved by Direccion General de Energia Nuclear, Spain's atomic-energy agency, to build a nuclear power station on the left bank of the Quadalquivir River near Seville in Andalusia. Plant will cost \$50 million, produce 50 mw., be completed in 1968. Still pending approval by the regulatory agency

are two other atomic-power projects: a similar nuclear plant proposed last summer by CENUSA, to be built on the Tagus River about 90 miles from Madrid; and a 600-mw. nuclear plant proposed by NUCLENOR, a privately held group of utilities in the north of Spain, to be built at Santa Maria la Garona on the Ebro River.

Australia: Imperial Chemical Industries of Australia and New Zealand Ltd. (ICIANZ) plans a \$2.8million carbon tetrachloride plant at Botany, in New South Wales. Due on stream by the end of next year, the petrochemical facility will feed on hydrocarbon stock from a nearby refinery. "A large part" of the output will be sold to two new firms, Australian Fluorine Chemicals Pty. Ltd., and Pacific Chemical Industries Pty. Ltd., to be used for making chlorofluorocarbons—a new industry for the continent. Scientific Design Co., New York, designed ICIANZ's carbon tetrachloride facility.

Canada: Howards and Sons (Canada) Ltd. has begun a \$500,000 expansion of its Cornwall, Ont., facilities. Scheduled for completion early next year, new unit will produce up to 8,000 tons/yr. of sorbitol, a chemical used chiefly by tobacco makers to control the moisture content of their product. Currently, Canada imports about 2,500 tons/yr. of sorbitol from the U.S.

Jamaica: Caribbean Cement Co. is doubling its 200,000-ton/yr. cement capacity at Kingston. Expansion includes a third kiln, a new raw mill and a finish mill, plus an electricity-generating station being built by Macdonald Engineering Co., Chicago. Project will cost \$6 million, come on stream in mid-1963.

People

Oscar G. Burch, vice president and technical director of Owens-Illinois Glass Co., has been named

М

Foxboro Target Flow Meter controls naphthalene on Hydeal Unit jointly developed by Universal Oil Products Co., Des Plaines, Ill., and Ashland Oil & Refining Co., Ashland, Kentucky.

Foxboro Target Flow Meters improve process control on Ashland Oil's huge naphthalene installation



r project pro-NUSA, River I; and oposed v held rth of Maria

al Inv Zea-\$2.8plant Vales. next cility stock large old to Fluand Pty. loroy for esign NZ's

Can-0,000 Ont., aplewill

of

iefly the

luct. bout

the

o. is

oannew

olus

tion

ngi-

will

in

ind Ili-

ned

VG

The Foxboro Target Flow Meter installs directly in the line. Stainless steel disc extends into stream, senses force of fluid pushing against it. Force is converted to pneumatic signal proportional to the square root of flow and transmitted to a remote Foxboro recorder or controller.

Tap-less meters handle naphthalene, and heavier aromatics - without plugging, fouling or leaking

Every month, some 8 million pounds of high grade naphthalene flow out of Ashland Oil's new Hydeal Unit at Ashland, Kentucky. To help control process flows at top efficiency, Ashland Oil relies on Foxboro Target Flow Meters.

Molten, viscous naphthalene, for instance, pours through the Foxboro Target Flow Meters without setting up in the line. That's because the meters have no pressure taps to foul or plugup. And the leak-proof, tap-less meters let Ashland Oil safely measure volatile and flammable fluids.

Foxboro Target Flow Meters take the guesswork out of measuring other hydrocarbons, heavy oils and viscous liquids, too. They introduce a standard of accuracy and repeatability previously unobtainable for these applications—right up to 750°F.

Find out now whether your tough flow measurement problems can be solved with Foxboro Target Flow Meters. For more complete details, write for Bulletin 13-31. The Foxboro Company, 3612 Neponset Avenue, Foxboro, Massachusetts.

FOXBORO

REG. U.S. PAT, OFF.

RENNEBURG

... designed for

processing light, fluffy materials

Renneburg Instantaneous

Dryers process fine wood fi-

bres, filter cakes, sewage sludge

and other types of particulate

solids, which can be pneumati-

cally conveyed at high veloci-

ties in a warm air stream to

CLONIC MATERIAL

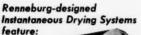
Instantaneous Dryer Sys-

tem shown in drawing has

approximately 250 feet of

remove moisture.

INSTANTANEOUS DRYING SYSTEMS





Refractoryless Furnace—Eliminates refractory cost and periodic maintenance . . . lighter in weight . . requires less costly foundation.



Air-Cooled Feed Duct Economizer— Permits recovery of heat radiated from inner feed duct . . . preheats secondary air flowing into furnace.



Cyclone Collector—Has helical type air inlet and scroll type outlet . . . provides greater collection efficiency with lowest pressure drop.



Advanced Instrumentation—Assures positive control of drying conditions . . has flame safety and explosion protection features.

ic control MATERIAL FEED TUBE

AIR COOLED MATERIAL FEED TUBE

Literature an

ductwork. Material is dried in less than 6 seconds.

EDW. RENNEBURG & SONS CO.

2639 Boston Street, Baltimore 24, Maryland



YLESS

NEW RENNEBURG SYMBOL—The solid "R" represents the solidity of a firm that has served the Process Industries for over 85 years. The full circle symbolizes the complete services rendered. The "flights" in the circle indicate Renneburg's technical "know-how."

CPI NEWS BRIEFS . . .

president of the sixth International Commission on Glass. The congress is scheduled for next July 8-14 in Washington, D. C., to disseminate knowledge and promote understanding among 600 glass-technology scientists from both sides of the Iron Curtain.

 \overline{C}

9-11

Cont

trica

Eng

Nat

and

Hot

12-1

char

Nev

Cor

23-2

1965

Sec

real

26-2

nac

31-2

Cal

Eng

5-9.

Ma

Sta

Rei

Ed

Air

frig

Me

Na Ok

As

En

fer Ho

En

Co

G. Rodney Wick is the new director of engineering and research at General Aniline & Film Corp.'s Chemical Group.

R. Terrence Webster has been promoted to production manager for Stauffer Chemical Co.'s Stauffer Metals Div.

Hugh F. Gillespie has been appointed chief industrial engineer by Taylor Fibre Co. He takes charge of manufacturing methods and standards at the firm's Betzwood, Pa., plant.

Howard A. Benzel, vice president of engineering at Scott Aviation Corp., has been promoted to senior vice president.

H. W. Holly has been named product manager for urethane elastomers at American Cyanamid Co.

Ernest F. Upton, Jr., has been appointed director of engineering by Fischer & Porter Co.

Karl L. Fetters, vice president of research and development for Youngstown Sheet and Tube Co., has been elected president of The Metallurgical Society of AIME for 1962. William B. Stephenson, president of Allen-Sherman-Hoff Pump Co., has been named president of AIME's Society of Mining Engineers and vice president of AIME itself.

A. J. Buselli will join Texas Butadiene & Chemical Corp. as vice president of research and development. He has been director of research for W. R. Grace & Co.'s Polymer Chemicals Div.

Robert C. Hyatt has been promoted to general manager of General Aniline & Film Corp.'s Antara Chemicals Div.

M I

Convention Calendar

erna-

The

next

C., to

pro-

600

from

irec-

arch

rp.'s

profor

ıffer

ap-

neer

akes

nods

etz-

dent

tion

nior

rod-

las-

Co.

ap-

y by

t of

for

Co.,

The

for

son,

Ioff

esi-

ing

of

ıta-

ice

op-

re-

o.'s

ro-

en-

ara

NG

n.

January

9-11. American Society for Quality Control, American Institute of Electrical Engineers, Institute of Radio Engineers, Electronic Industries Assn., National Symposium on Reliability and Quality Control, Statler-Hilton Hotel, Washington, D. C.

12-15. American Institute of Mechanical Engineers, Annual Meeting, New York, N. Y.

22-25. National Plant Maintenance and Engineering Show & Conference, Convention Hall, Philadelphia, Pa.

23-26. Canadian Pulp & Paper Assn., 1962 Annual Meeting of the Technical Section, Queen Elizabeth Hotel, Montreal, Can.

26-2. American Management Assn. Quality Control, AMA Academy, Saranac Lake, N. Y.

31-2. University of California, Gas Chromatography Course, Los Angeles, Calif.

February

4-7. American Institute of Chemical Engineers, National Meeting, Hotel Statler, Los Angeles, Calif.

5-9. American Society for Testing Materials, Committee Week Meeting, Statler-Hilton Hotel, Dallas, Tex.

6-8. Society of the Plastics Industry, Reinforced Plastics Div. Conference, Edgewater Beacl. Hotel, Chicago, Ill.

12-15. 12th National Exposition of the Air-Conditioning, Heating and Refrigeration Industry, Great Western Exhibit Center, Los Angeles, Calif.

18-22. American Institute of Mining, Metallurgical & Petroleum Engineers, Annual Meeting, New York, N. Y.

21-23. Oklahoma State University, National Gas Conference, Stillwater, Okla,

March

 Drug, Chemical & Allied Trades Assn., 36th Annual Dinner, Waldorf-Astoria Hotel, New York, N. Y.

4-7. American Society of Mechanical Engineers, Gas Turbine Power Conference & Exhibit, Shamrock-Hilton Hotel, Louston, Tex.

5-8. American Society of Mechanical Engineers, 7th Annual Gas Turbine Conference & Products Show, and 2nd Annual Process Industries Conference, Shamrock-Hilton Hotel, Houston, Tex.

13-14. Manufacturing Chemists' Assn., 2nd Symposium of Packaging of Chemical Products, Chase-Park Plaza Hotel, St. Louis, Mo.

13-15. Southwest Research Institute and Research Branch, Office of the Chief of Ordnance, Dept. of Army, Symposium on Application of Statistics and Computers to Fuels and Lubricants Research Programs, Granada Hotel, San Antonio, Tex.

14-16. Instrument Society of America, 12th Annual Conference on Instrumentation for the Iron & Steel Industry, Hotel Roosevelt, Pittsburgh, Pa.

15-23. American Society of Tool & Manufacturing Engineers, Engineering Conference anl Exhibit, Cobo Hall, Detroit, Mich.

19-23. National Assn. of Corrosion Engineers, Annual Conference and Show, Municipal Auditorium, Kansas City, Mo.

20-29. American Chemical Society, National Meeting, Washington, D. C.

April

2-4. National Petroleum Refiners Assn. Annual Meeting, Granada Hotel, San Antonio, Tex.

9-10. Instrument Society of America, 4th National Chemical & Petroleum Instrumentation Symposium, Wilmington, Del.

9-13. American Welding Society, 43rd Annual Convention & Welding Exposition, Cleveland Public Auditorium and Sheraton Cleveland Hotel, Cleveland, Ohio.

17-19. American Society for Metals, Regional Conference & Exhibition: Materials and Materials Processing for the Petroleum, Petrochemical and Chemical Industries, Shamrock-Hilton Hotel, Houston, Tex.

23-25. 1962 Powder Metallurgy Show, Hotel Sheraton, Philadelphia, Pa.

24-25. Chemical Engineering & Southwest Research Institute, Management of Petroleum and Petrochemical Operations, Granada Hotel, San Antonio,

25-27. Natural Gas Processors Assn., 41st Annual Convention, Denver-Hilton Hotel, Denver, Colo.

30-2. Instrument Society of America, 8th National Symposium on Instrumental Methods of Analysis Contact, Daniel Boone Hotel, Charleston, W.

Size Requirements Getting Tougher?

Sturtevant Air Separators Increase 40 to 400 Mesh Output as Much as 300%



Closed-circuit air separation is of proved advantage in reduction processes. Result is a better, more uniform product. Grinding mills perform at top efficiency, output frequently increases as much as 300%, power costs drop as much as 50%.

Precise separation of all dry powdered materials. Sturtevants currently classify sulfur, soybeans, phosphate, chocolate, feldspar, sand and aggregates, pigments, limestone fillers, flour, abrasives, plastics, gypsum, ceramics, cement and other products.

Improve screening — Sturtevant Air Separators prevent blinding by removing undesirable tailings *or* fines from screen feed loads.

Works Like Winnowing Done in a Whirlwind

Sturtevant Air Separators do a mechanical job of winnowing. Precise control of whirlwind air currents and centrifugal force results in the desired size being lifted into fines cone, oversize falling into tailings cone.

A 16 ft. Sturtevant, for example, has taken a feed rate of 800 tph, containing only a *smali* percentage of desired fines, and delivered 30 tph 90% 200 mesh, recirculating the oversize through the grinding circuit.

Send for Bulletin No. 087.

STURTEVANT

MILL COMPANY

100 Clayton St., Boston, Mass.

Crushers • Grinders • Micron-Grinders • Separators Blenders • Granulators • Conveyors • Elevators

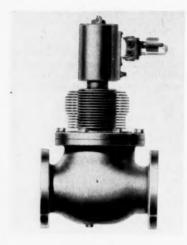
for your free

Vacuum Slide Calculator.

NEW EQUIPMENT . . .

Continued from page 52

2 sec., according to the manufacturer. Applications include flue-and oven-gas analysis.—The Hays Corp., Michigan City, Ind. 52C



Gas valve

Unit for remote operation serves at wide temperature extremes.

A full-flow shutoff valve provides remote actuation for either opening or closing by means of a 4-way solenoid. Normalizing fins have been designed to permit the unit to operate with fluids at temperatures ranging from -350 to +800 F.

Available in all ASA pressure ratings and sizes, ½ in. through 12 in., the valve is available with screw connections up to 2 in., flange connections above 2 in., and weld connections for all sizes. Body materials may be cast iron, carbon steel, stainless steel, or others that may be required.—Security Valve Co., South Pasadena, Calif.

Vibrating mixer

Sealless unit can serve for both pressure and vacuum applications.

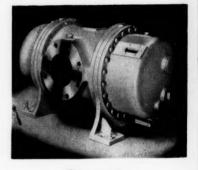
A unit called the Vibro-Mixer operates with only one moving part—a vibrating shaft and disk moving up and down in short,

power strokes. It was described earlier in this department (*Chem. Eng.*, Nov. 27, p. 78) but more information is now available on its characteristics and performance.

In addition to being able to mix with comparatively low power-input, the device has no stuffing boxes or seals to cause trouble in closed systems, and no bearings or guides that require lubrication. Adjustable plain membrane seals are part of the unit, permitting pressures to 6,000 psi. in laboratory autoclaves, and to 500 psi. in industrial models—and, of course, full vacuum.

For work at high pressures, the vibration is transmitted through a radial to-and-fro movement instead of longitudinally along the shaft. Special stirring elements are used for both liquid and gas circulation under these conditions.

—Hudson Industries Corp., Newark, N. J.



Gas meter

Positive-displacement unit has high capacity at pressures to 125 psi.

si

e

c

C

With a wide working range from low pressure to 125 psi., this rotary positive-displacement meter is available in capacities from 16,000 to 102,000 cfh.

In operation, two lobe-type impellers rotate with minimum clearances for accurate volumetric metering. Accuracy is said not to be affected by variations in specific gravity, fluctuating flows, or pressure pulsations. An easily read digital totalizer is standard equipment on each meter case.

Newly designed, the instrument is considerably lighter than pre-

REVISED New-Diagrammatic procedure of closed-circuit unloading for odor control STORAGE AND HANDLING OF ACRYLATE AND METHACRYLATE ESTERS New-Lower cost installation suggestions New-Procedure for drumming shipments ROHM & HAAS COMPANY SPECIAL PRODUCTS DEPARTMENT NASHINOTON SQUARE, PHILADELPHIA 6. PA New-Itemized equipment lists, cost estimates, and return-on-investment calculations

Guide to safer, lower-cost handling of Acrylic Monomers

This new, revised bulletin gives you the most up-to-date information on storage and handling of acrylic monomers. Data and recommendations are based on Rohm & Haas' extensive engineering research and experience in acrylic monomer handling. Included are (1) new suggestions for lower-cost storage installations, (2)

scribed

(Chem.

ore in-

on its

nance. to mix power-

tuffing

arings cation.

seals

nitting

abora-

psi. in

ourse,

es, the

rough

nt ing the

ments d gas

tions.

New-120B

high

from

eter

from

im-

ear-

me-

cific res-

ead

uip-

ent

ore-

NG

si.

item-by-item equipment lists, installation cost estimates, and return-oninvestment calculations for profit plan-





ning, (3) procedures for safe drumming of bulk shipments, and (4) a diagrammatic procedure of closed-circuit unloading of bulk shipments for odor control. Get the benefit of Rohm & Haas' continuing leadership in technical service, and save on your acrylic monomer purchases. Write to Dept. SP-31 for your copy today.

Rohm & Haas Acrylic Monomers

Methyl Acrylate • Ethyl Acrylate • Butyl Acrylate • 2-Ethylhexyl Acrylate • Methyl Methacrylate Ethyl Methacrylate • Butyl Methacrylate • Hexyl Methacrylate • Decyl-octyl Methacrylate Lauryl Methacrylate • Stearyl Methacrylate • Dimethylaminoethyl Methacrylate • t-Butylaminoethyl Methacrylate • Glacial Acrylic Acid • Glacial Methacrylic Acid.



New Selas in-line micro-filters offer top performance at low cost.



SERIES C MICRO-FILTERS with uniform microporous porcelain elements, are available in seven different grade porosities retaining maximum particle sizes of 25, 10, 2, 1.5, 0.7, 0.4 or 0.3 microns. Interchange of element grades permits filter use for different polishing jobs.



SERIES M MICRO-FILTERS with uniform microporous stainless steel elements are available in seven different grade porosities retaining maximum particle sizes of 125, 70, 50, 27, 17, 10 and 5 microns. Filter elements offer high mechanical strength plus ability to handle corrosive fluids at high temperatures.



FLO-SCREEN FILTERS are available in eight graded porosities of stainless steel screens retaining maximum particle sizes of 80, 55, 35, 22, 12, 7, 3 or 2 microns. Flo-Screen filter elements offer extremely rapid flow rates and complete absence of particle migration.



NEW EQUIPMENT . . .

vious models of the same line. Inlet and discharge connections are aligned to simplify piping during installation. An instrument drive and instrumentation for recording and telemetering can be furnished. —Roots-Connersville Blower, div. of Dresser Industries, Inc., Connersville, Ind. 120C



Level controller Ultrasonic device operates without depending on fluid properties.

An explosion proof ultrasonic switch controls liquid level under the most severe conditions. Unit is triggered instantly when any liquid touches the probe surface. Device can repeat within "thousandths of an inch," according to the manufacturer.

Unit operates in any position, is not affected by foam, droplets or film build-up. Also, the Sonoswitch requires no adjustment for temperature shifts or pressure variations, since it operates independently of fluid properties. Typical applications include over-fill alarms, automatic pump startup and shutdown, low-level indication. — Powertron Ultrasonics Corp., Plainview, N. Y. 122A

Flow control valve Check valve and contoured needle aid in control at up to 5,000 psi.

For oil or air pressures up to 5,000 psi., this 1-in. control valve has a 5 to 1 safety factor. The unit incorporates a check valve that permits unobstructed flow in one direction, and a contoured needle that provides a wide range of flow adjustments in the opposite, or

controlled, direction.

Frictional losses through the check valve are claimed to be low because as the ball moves off its seat, it seals off the spring chamber, isolating the spring and diverting the flow through a maximum-flow path.

Leve

nitro

low-

uppe

in a

level

cont

liqui

per :

Inc.,

Desi

poin

men

110-

heat

mate

deliv

land

Zone

cent

gani

rials

310

melt

glas

The

N. .

Equ

Ava

Cem

Cher

Clay

Glas

Pain

Pape

Petro

Rubb

Proc

R

Elec.

Mini

Refr

Stea

Com

Needle adjustments may be made under maximum rated pressure without effort. Special needle configurations and orifice openings are available to provide sensitive flow-control adjustments, or for large flow demands. — Auto-Ponents, Inc., Bellwood, Ill. 122B



Mixer

Unit's mixer head can be raised or lowered hydraulically.

Called the type V. S. high-speed agitator, this unit has a built-in hydraulic cylinder that raises or lowers the mixer head. (Head can be raised 42 in. above operating position.) Mounted within the unit's control pedestal are a hydraulic pump and reservoir, hydraulic control valves and allelectric starters in an explosion-proof enclosure.

Mixer has variable-speed drive (from 600-2,100 rpm.), and is available with three different motors: 15, 20 or 25 hp. A handwheel adjusts speed of 2-in. shaft.—Patterson Foundry and Machine Co., East Liverpool, Ohio. 122C

۷I

Briefs

h the

be low

off its

cham-

nd di-

max-

y be

pres-

needle

opensensi-

ts, or

Auto-

122B

sed

peed lt-in

s or

can

ting

the

all-

ion-

rive is moheel

Pat-

Co.,

22C

NG

e a

Level-control system for liquid nitrogen in cold traps and other low-temperature vessels has an apper/lower-limit sensor mounted in a probe configuration. When level drops below a set lower limit, controller initiates transfer of liquid into the cold trap until upper limit is reached.—Cryogenics, Inc., Stafford, Va. 123A

Desiccant dryer delivers low-dewpoint air for process and instrument use. Compact unit needs 110-v., a.c. power for electrical heater that reactivates desiccant material. Operating at inlet pressures from 10 to 90 psi., the device delivers air with a dewpoint of 100 F. below ambient temperature.—Trinity Equipment Corp., Cortland, N. Y. 123B

Zone-melting unit refines and concentrates from 0.15 to 10 g. of organic compounds and other materials. Maximum temperature of 310 C. is obtained as a ½ to ½-in. melting zone moves down a 6-in. glass tube at a rate of 1 in./hr.—The Torsion Balance Co., Clifton, N. J.

Equipment	Cost	Indexes	
		June	Sept.
		1961	1961
Industry			
Avg. of all		236.9	237.2

Process Industries

Cement mfg.					٠	230.9	231.1
Chemical						237.3	237.7
Clay products						224.4	224.6
Glass mfg						224.0	224.4
Paint Mfg						229.4	230.3
Paper mfg						228.6	229.0
Petroleum ind						234.8	235.2
Rubber ind						237.6	238.1
Process ind.						235.2	236.2

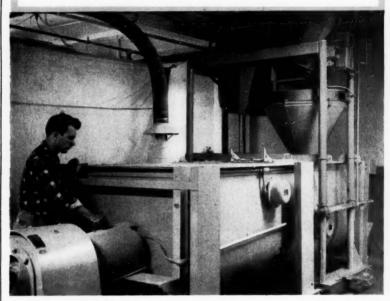
Related Industries

Elec. power equip	235.1	235.8
Mining, milling	238.7	239.2
Refrigerating	268.6	269.1
Steam power	250.0	225.5

Compiled quarterly by Marshall and Stevens, los Angeles, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124-6 for method of obtaining index numbers; Mar. 6, 1961, pp. 115-116 for annual averages since 1913.

ENTOLETER® IMPACT MILLS

...true control assured for Colgate's "Ajax" line



- · Improved Product Quality
 - · Elimination of Production Bottleneck
 - Trouble-Free, Efficient Operation

Colgate-Palmolive has found that ENTOLETER IMPACT MILLS provide real benefits in processing "Ajax" household cleanser.

Engineered for simultaneous blending, grinding, and deagglomerating action, the IMPACT MILLS deliver a completely homogeneous, smooth-textured product.

With capacity per machine of 171/2 tons/hr, these mills require less than 2.3 HP/ton/hr... Provide satisfactory wear life on highly abrasive materials.

Proven successful at Colgate's oldest and largest plant in Jersey City, ENTOLETER IMPACT MILLS have been installed in other "Ajax" producing plants throughout the U.S.

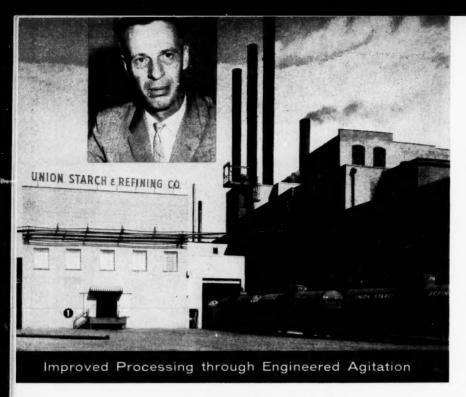
The Colgate-Palmolive Co. reports that "Blocking, packing, poor flow, and lack of product uniformity were ever present problems when the hammer-mill pulverizer was used. Installation of the ENTOLETER MILL gave TRUE CONTROL of the 'Ajax' line for the first time, including the automatic packaging step".

Investigate the advantages of Centrifugal Impact Mills TODAY! Write or phone for additional information and FREE LABORATORY TEST SERVICE.

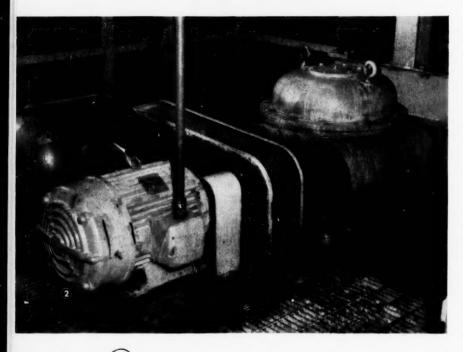


ENTOLETER INC.

1117 Dixwell Ave., New Haven 14, Connecticut STate 7-3575



- 1. Union Starch & Refining Co., Granite City, III.
- Nettco Tank Top Agitator with two 25 hp motors, one operating — one as spare.





ADD STARCH AND STIR... UNION'S BIG RECIPE PAYS OF

RI

it

a

Nettco Solves Suspension Prof for Union Starch and Refining

PROBLEM:

Keeping a huge tank inventory of 192,000 gallons of starch liquoring constant suspension to satisfy a continuous demand 24 hours per 7 days per week.

SOLUTION:

Nettco engineers working closely B. J. Hunter, director of manufact determined the exact agitation requirement to maintain contents uniform suspension at minimum By drawing on years of specialized agitation experience, Nettco was a utilize one of its standard tank to units — a 40 foot shaft, precision engineered to eliminate whip — an the right type and size of impeller minimum horsepower.

RESULT:

Rugged, dependable agitation at lo initial and operating cost. Repaym of original investment in tank and agitator in one year.

Try the pay-off combination of Net standard components, engineering imagination on your next mixing. See Chemical Engineering Catalog nearest representative or request Bulletin 581, Nettco Corporation. 87 Tileston St., Everett 49, Mass.

Technical Bookshelf

RING OUT THE OLD

sion Pro

Refining

ventory of

h liquori

atisfy a

ours per

g closely

manufact

tation

contents

inimum

pecialized

co was a

I tank top

recision

hip — an

mpeller

tion at lo

Repaym

nk and

n of Net

ineering

nixing

Catalog

quest

oration.

Mass.

The year has almost ended. And the tiers of Technical Bookshelf are groaning and swaying under the greatest tonnage of material ever. If literature progress can be measured by total weight, then 1961 has been far and away the most progressive literature year of all time.

Along with weight increase, however, has come a heightening of quality. We think this is due mostly to the entry of small publishing houses into the field, or to the expanding efforts of these firms. This competition has prodded the larger companies—already highly competitive with each other—to appreciably extend their efforts.

The result is a better product for you. It means better content and visual format. It means increasingly accurate and detailed indexing and cross-referencing. It means updated and more-comprehensive bibliographies. (Indirectly, to be sure, it also means an increase in price.)

We've tried to include a wide range of subjects in our reviews. Admittedly, some of the material achieves a narrow range of readership. But we attempt to do justice to the literature in all the many segments of the chemical process industries.

Here is a flash preview of some Technical Bookshelf features for 1962. An issue upcoming shortly will carry the results of a poll among CE editors on "What are the indispensable books for chemical engineers?" Then we've planned two "double reviews"—wherein two reviewers write independent critiques of the same work. And we've scheduled several reviews of new books on the basic subject of Chemical Engineering (seems to have been a shortage of these, but no longer.)

Also on deck: rundowns of the most recent outer-space texts and the latest volumes on methods of technical writing and scientific reporting.

Until next year, merriest season's greetings!—HSG



These twin rotary dryers are aluminum. STANDARD, of course, also makes dryers of other materials. What makes Standard Steel the important name in dryers? Several things. For one, pilot plant studies make sure they will do the job

well. For another, STANDARD dryers are built to last. Take a close look at the heavy-duty trunnions, thrust rolls, gears, tires, modern drives, anti-friction bearings, metal to metal seals. There's good stuff in Standard Steel products. Let our engineers help you with drying problems.

STANDARD STEEL CORPORATION

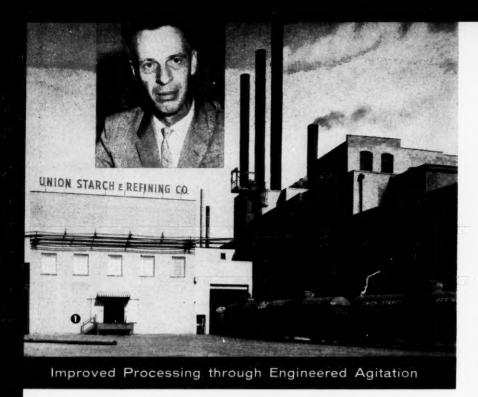
General Offices & Plant, 5005 Boyle Avenue, Los Angeles 58, California

Midwest Offices & Plant LEADER IRON WORKS Decatur 5, Illinois

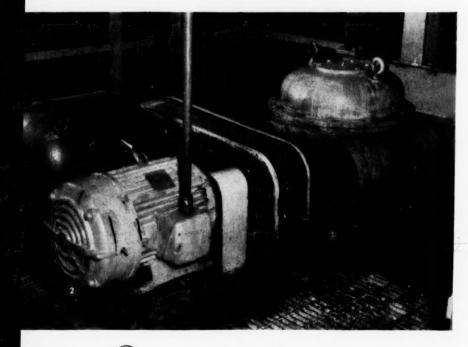
(Division of Standard Steel Corporation)

ROTARY DRYERS . KILNS . COOLERS . ASPHALT PLANTS





- 1. Union Starch & Refining Co., Granite City, III.
- Nettco Tank Top Agitator with two 25 hp motors, one operating — one as spare.





ADD STARCH AND STIR... UNION'S BIG RECIPE PAYS OFF

RI

Th

gr gr

ur be

ev

ab

yo

vis

pr

ra

A

ac

se

Te

am

en

tig

Ch

mo

gr

Nettco Solves Suspension Prob for Union Starch and Refining 0

PROBLEM:

Keeping a huge tank inventory of 192,000 gallons of starch liquor in constant suspension to satisfy a continuous demand 24 hours per d 7 days per week.

SOLUTION:

Nettco engineers working closely w B. J. Hunter, director of manufactu determined the exact agitation requirement to maintain contents i uniform suspension at minimum co By drawing on years of specialized agitation experience, Nettco was ab utilize one of its standard tank top units — a 40 foot shaft, precision engineered to eliminate whip — and the right type and size of impeller is minimum horsepower.

RESULT:

Rugged, dependable agitation at lo initial and operating cost. Repayme of original investment in tank and agitator in one year.

Try the pay-off combination of Net standard components, engineering imagination on your next mixing jo See Chemical Engineering Catalog nearest representative or request Bulletin 581, Nettco Corporation, 87 Tileston St., Everett 49, Mass.

Technical Bookshelf

RING OUT THE OLD

OFF

ion Prob

efining C

ntory of

liquor in

urs per d

closely w

anufactu

ontents

imum co

cialized

was ab

ank top

cision

p — and

peller f

n at lo

epayme

c and

of Nett

eering

king jo

atalog

iest

ation,

lass.

tion

tisfy a

The year has almost ended. And the tiers of Technical Bookshelf are groaning and swaying under the greatest tonnage of material ever. If literature progress can be measured by total weight, then 1961 has been far and away the most progressive literature year of all time.

Along with weight increase, however, has come a heightening of quality. We think this is due mostly to the entry of small publishing houses into the field, or to the expanding efforts of these firms. This competition has prodded the larger companies—already highly competitive with each other—to appreciably extend their efforts.

The result is a better product for you. It means better content and visual format. It means increasingly accurate and detailed indexing and cross-referencing. It means updated and more-comprehensive bibliographies. (Indirectly, to be sure, it also means an increase in price.)

We've tried to include a wide range of subjects in our reviews. Admittedly, some of the material achieves a narrow range of readership. But we attempt to do justice to the literature in all the many segments of the chemical process industries.

Here is a flash preview of some Technical Bookshelf features for 1962. An issue upcoming shortly will carry the results of a poll among CE editors on "What are the indispensable books for chemical engineers?" Then we've planned two "double reviews"—wherein two reviewers write independent critiques of the same work. And we've scheduled several reviews of new books on the basic subject of Chemical Engineering (seems to have been a shortage of these, but no longer.)

Also on deck: rundowns of the most recent outer-space texts and the latest volumes on methods of technical writing and scientific reporting.

Until next year, merriest season's greetings!—HSG



These twin rotary dryers are aluminum. STANDARD, of course, also makes dryers of other materials. What makes Standard Steel the important name in dryers? Several things. For one, pilot plant studies make sure they will do the job

well. For another, STANDARD dryers are built to last. Take a close look at the heavy-duty trunnions, thrust rolls, gears, tires, modern drives, anti-friction bearings, metal to metal seals. There's good stuff in Standard Steel products. Let our engineers help you with drying prc. !ems.

STANDARD STEEL CORPORATION

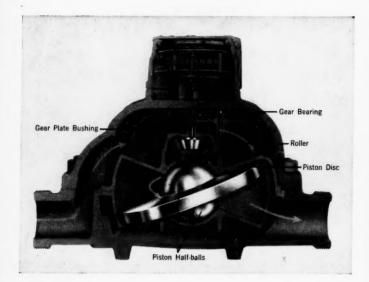
General Offices & Plant, 5005 Boyle Avenue, Los Angeles 58, California

Midwest Offices & Plant LEADER IRON WORKS Decatur 5, Illinois

(Division of Standard Steel Corporation)

ROTARY DRYERS . KILNS . COOLERS . ASPHALT PLANTS





KEL-F° foils corrosive attack, keeps meters on the mark!

Equipment that measures even highly corrosive liquids can be enduringly exact, too! Buffalo Meter Company manufactures meters that measure precisely the flow of over 100 corrosive chemicals, including acetic acid. aluminum nitrate, carbon bisulfide, diethylamine, phosphoric acid, potassium chloride and concentrated sulphuric acid. Vital meter parts-piston discs, half balls and other components, as shown-are made of KEL-F Brand Plastic because it retains its shape and dimension in the presence of corrosive chemicals, even fuming nitric acid.

Other properties which led to the selection of KEL-F Plastic for this application include stability, easy moldability, low cold flow, low specific gravity and good lubricating qualities. The five meter components of KEL-F Plastic are molded for Buffalo Meter Company by Resistoflex Corp., Roseland, N.J., and the Garlock Packing Co., Palmyra, N.Y.

Now, new KEL-F 81 Plastic incorporates many property advantages, along with better-than-ever uniformity and consistency. For more information, read the "profile" to the right, then return the coupon below.

Chemical Division, Dept. KAL-121 3M Company St. Paul 6, Minn.	TELL ME MORE about KEL-F 81 Plastic
Name	
Title	
Company	- 144
Address	
City & State	

Properties Profile

on

KEL-F°81 PLASTIC

KEL-F 81 Plastic is a fluorocarbon plastic, a thermoplastic resin formed by the homo-polymerization of chlorotrifluoroethylene. The high degree of fluorination of KEL-F 81 Plastic is responsible for its chemical inertness and thermal stability. The inclusion of chlorine in an otherwise carbon-fluorine molecule results in exceptional moldability and mechanical toughness.

Crystallinity. KEL-F 81 Plastic is crystallizable, but not necessarily crystalline, the degree and kind of crystallinity in a given sample being a function of its thermal history. The "quick-quenched" resin is spoken of as amorphous, and the "slow-cooled" resin as crystalline. When crystalline, KEL-F 81 Plastic is a denser, more translucent material with higher tensile modulus, lower elongation, and greater resistance to the penetration of liquids and vapors. The amorphous plastic is less dense, more elastic, with greater optical clarity and toughness.

Physical Properties. The physical properties of KEL-F 81 Plastic combine mechanical, chemical, electrical, and optical advantages. And the most useful applications center around combinations of the following properties:

- 1. Useful temperature range: from -400° F. to $+400^{\circ}$ F.
- 2. Resistance to deformation and flow at high temperatures, pressures
- 3. Zero moisture absorption
- 4. Abrasion resistance
- 5. Radiation resistance
- 6. Chemical resistance
- 7. Electrical properties 8. Infrared transmission
- 9. Inert to liquid oxygen
- 10. Flexible in contact with cryogenic fuels

Processing. KEL-F 81 Plastic can be processed in the same manner as other thermoplastic resins. Parts of KEL-F 81 Plastic may be specified in any form.

Detailed data on physical properties is contained in a new free brochure. For your copy, return coupon or write to 3M Chemical Division, stating area of interest.

"KEL-F" is a reg. TM of 3M Co.

CHEMICAL ENGINEERING

Volume 68 1961

Published biweekly by
McGRAW-HILL PUBLISHING COMPANY, INC.
NEW YORK

Chemical Engineering

J. ELTON TUOHIG

CECIL H. CHILTON Editor-in-Chief Batch Batc rej

Bate of & How C. Bauxit un (cl Beer—hy Benzer oill Dow tw HDA but to (N Hyde pressure pet to for the pet to the to

Petro (ci Phill ber Berylli

Bleach use der Book I Boile fun The tili

Chen ste Comp edi Ins

ing

Cryst Diazo and ing The Cos The by Engin S. Fatty ties ed. Fuel Cel

Hand con A hi

Indus
Jr.
Infor
tra:
A.
Isoto:
Mei
Mana

Mathand The scie

Organ H. An claw Physi try, Ed.

In August 1946 Chemical & Metallurgical Engineering was renamed Chemical Engineering. Chemical & Metallurgical Engineering was the successor to Metallurgical & Chemical Engineering, which, in turn, was a consolidation of Electrochemical & Metallurgical Industry and Iron & Steel Magazine. The magazine was originally founded as Electrochemical Industry.

McGRAW-HILL PUBLISHING COMPANY, INC., NEW YORK CITY

Volume 68

January to December 1961

GENERAL ALPHABETICAL INDEX

A		Air Conditioning—Simultaneous transfer of heat and mass. CE Refresher. Coates & Pressburg (charts). Pt 1		Amines Methylamines—bullish outlook sires expansion at Rohm & Haas—flow-	
Acetaldehyde-Ethylene oxidation: Alde-	_	May 29-95, Pt 2 June 26-131, Pt 3		sneetAug 21	010
hyde GmbH's direct, low-cost route to acetaldehyde (charts & tables)	9	July 24	151	synthesisOct. 30	
(N)	66	Aldox process-Humble's new route to		Ammonia	
new resinsSept. 18	86	higher-alcohol rivals Conoco's (N)		Ammonia blanket gives low-biuret urea prills (N)Oct. 30	
Acids		Alfols—Conoco's synthesis of straight-			
Acetic and formic acids recovered from	,	chain primary alcohols wins Kirk-		Memphis, Tenn., plant May 1 Railway tank car hauls low-tempera-	*5
sulfite liquor by Sonoco Products	3	chain primary alcohols wins Kirk- patrick Award honors (N)Oct 2	46	ture ammonia (N)Aug. 7	4.75
(chart) (N)	*124	Allyl alcohol's physical properties	*198	Storage—swing to cold NH3 saves stor-	-1
uses multistage air oxidation of ev-		summarized. E. M. Braun (table)		age \$5 (N)	* 2
cionexane (chart) (N)Apr. 17	130	(P. N.)	102	Ammonium metatungstate July 24 Argentina will build first HDA benzene	8
Citric acid—Bzura process—flowsheet	*100	Furfuryl alcohol derived from grain gets Nebraska plant (N)Dec. 25	32	plant (N) May 15	71
Sulfamic acid powders for cleaning	-122	Furfuryl alcohol resins improved by	0.0	Aspestos - Tenon-impregnated ashestos	
Feb 20		amino crosslinkers Mar. 20	105	makes low-price packingJan. 23	*98
Sulfonated fatty acid surfactants Oct. 2	60	Polyvinyl alcohol (PVA) pushes for big markets (N)Aug. 21	661	Atomic Power AEC picks plants for spent-fuel re-	
Thioacetic acid in semicommercial	-	Alum-Dixon Chemical's modern alum	001	processing (N)July 24	71
quantitiesJune 12 Versatic acids, Shell's synthetic organic	108	plant-flowsheet, E, K, Sheldon		Hallam, Neb., nuclear plant to have	
acids, make stable resins (N)		Mar. 20	*132	radiation available for processing. E. G. Lowell (charts & tables)	
Sent 19	70	Alumina		Aug. 21	*107
Acrylic coatings May 15-84, July 10		Africa's first alumina plant at Fria, Guinea, reshapes Bayer process		Industry reexamines economics of	
Acrylonitrile—Price drop may win daz-		(chart) (N)Oct. 2	*42	atomic fuels (N)June 12 Inventory—semiannual inventory of	93
zing markets - capacity, end-uses		Colloidal alumina powder, called	20	new nuclear processes and tech-	
(table) (N)Sept. 4	62	BaymalJune 26 Pellets boost efficiency of gas dehydra-	76		125
Adhesives		tionSept. 18	86	Japan maps 20-year plan for atomic progress (N)	96
Epoxy adhesive allows bonding of		Aluminum		raper mili seeks nuclear steam supply	
nylon to nylon	90	Aluminum barges, railcars bid to		(N) Sept. 4 Radioactivity—Design: key to min-	74
		replace steel (N)Apr. 3 Aluminum use to double in decade,	102	imizing plant radiation hazards. Pt 2 L. J. CherubinApr. 3	
Epoxy pellets bond by melting in place		Kaiser survey shows (table) (N)		Pt 2 L. J. Cherubin Apr. 3	*163
Phenol price cut stirs up plywood	82	Jan. 9	46	Radioisotopes help solve CPI engineer- ing problems. Overman & Rohrman	
adhesives market (N)	52	Aluminum tank repair by welding— manual offered	198	(tables) Feb 20	*151
applications tally for adhesive	*62	Crystal-making technique opens way to		Reactors—organic-moderated reactors rate high as ship and power units	
	-62	aluminum from clay (N) May 1 Diffusion coatings—aluminum-iron and	*36	(N) (charts) Mar 20	*82
slippery surfacesFeb. 6 Polysulfide-epoxy structural adhesive	*66	aluminum-nickel	116	Two small atomic devices for generat-	
Jan. 9	58	Insulation teams siliceous fibers and	5.0	ing electricity (N)Apr. 3 U.S.S.R. lists achievements in nuclear	104
Adsorption	90	aluminumOct. 2 Navy brightens aluminum picture (N)	58	energy (N)Oct. 2	54
Designing a fluidized adsorber. E. D.		Feb. 6	48	Automation	
	87	Outlook—Forecast for '61 reportJan. 9 Powdered aluminum gains in rocket	*91	German CPIbig market for computers (N)	72
			67	Joint Automatic Control Conference	14
Linde Co. wins CE's Kirknetrick	*72	"Square-butt" method speeds welding	****	(JACC) stresses economics (N)	
		of thick aluminum cylinders. Jan. 9 Superpure A1—electrolytic process ups	*132	Pilot plant runs itself by computer.	72
	*189	output, spurs expansion (chart) (N)		Dowding & Russell (charts & tables)	
ment—Upgrading nature S D Kirk		Tubular hanner care to hard hall	44	Process control—chemical engineers	*97
	*192	Tubular hopper cars to haul bulk chemicals (N)July 10	*74	must step up application (N)	
"Loaded" molecular sieves are key to one-component epoxies		Aluminum sulfate—Olin Mathieson's eco-		Jan 23	88
ought rennery uses automated con-	*68	nomical process for producing alumi-	*36	Automobiles—Seat belts boost nylon-fiber market (N)	74
		num sulfate from clay (N)May 1 American Association of Cost Engineers	- 90	Awards	1 2
orizing (chart) (N)July 10 Africa—Alumina plant at Fria, Guinea,	*64	-Chilton, Cecil H. elected president		Hoover Medal awarded to Morvin I	
		(N)	56	Kelly (N)	76
(chart)Oct. 2	*42	neers. Report on dynamic objectives		Linde and other winners (N) Dec 25	*34
Agricultural Chemicals		for chemical engineeringDec. 11	158	Kirkpatrick Award for Chemical Engi-	0.1
Fertilizers see under Fertilizers		American Management Assn.—Book of case studies for supervisors—sample		neering Achievement-winner: Linde	*46
Japanese antibiotic checks rice pest		case	196	Nov. 13 *	
Solan increases crop yields, allows	52	American Society for Metals-Informa- tion retrieval program-computer re-		Jesse H. Neal Award of Merit to CE	
mechanical harvesting Dec 11	94	trieves abstracts in split seconds		editorial staff (N)June 12 Walker Award to Northwestern's Pro-	•7
Spray keeps grass shortJune 26	*76	(chart) (N)July 24	*68	fessor Joe. M. SmithJan. 9	122

MΙ

Ш

	В	
	Bactericide for swimming pools	104
	hydrocarbons (N)	54 64
	Batch Operations Batch distillation of binary mixtures— Batch distillation of binary mixtures— Batch Operations Batch Operations Batch Operations	•87
	Batch distillation—Review principles of distillation—CE refresher. Coates	
7	& Pressburg (charts)Jan. 23 How many batches should you plan?	*131
al	C. D. Hendrix	153
y.	Feb. 6 Batch distillation—Review principles of distillation—CE refresher. Coates & Pressburg (charts)Jan. 23 How many batches should you plan? C. D. Hendrix. Dec. 11 Bauxite—Africa—alumina plant is key unit in bauxite-mining complex (chart) (N)Oct. 2 Beer—freeze-concentration process dehydrates beer (N)Nov. 13	• 42
	hydrates beer (N)Nov. 13	122
_	coke-oven producers move to counter oil's competition (N)June 26	72
	two plants, new process (N). Apr. 17	132
	pow Chemical enters production with two plants, new process (N). Apr. 17 HDA process—first HDA plant will be built in Argentina (N)May 15 HDA, thermal hydrodealkylation route to petrochemical benzene (chart) (N)Apr. 17	72
	to petrochemical benzene (chart) (N)	128
		*70
	Petrochemical benzene: more and more (chart) (N)	76
		*56
	Beryllum concentrates to be produced from U. S. deposits by two competing processes (chart) (N). July 24 Brusi: Beryllium expansion bustling Sent. 4 Sent. 4	*66
*100	Brush Beryllium expansion bustling Sept. 4	*76
72	Bleaching—Pulp—new dewatering units use hydrogen peroxide to bleach denser pulp (N)Oct. 16	106
60	Rook Reviews	256
*50	Boilers: types, characteristics, and functions. C. S. Shields Sept. 18 The chemistry and technology of fer- tilizers. Ed. by Vincent Sauchelli	
*88	Chemistry of the amino acids. Green-	202
82 72	Chemistry of the amino acids. Apr. 3 stein & Winitz. 3 vols	
*98	edition. Compressed Air and Gas Institute Oct. 2 Cost engineering in the process indus- tries. Ed. by C. H. Chilton and staff of "Chemical Engineering". Feb. 20 Cost reduction guide for manufactur- ing management. Wyatt & Morse Aug. 7	164 214
76	Cost reduction guide for manufactur- ing management. Wyatt & Morse Aug. 7	181
*107	The crisis we face—automation and the cold war. Steele & Kircher Jan. 9 Crystallization J. W. Mullin Oct. 16	160
93	and assematic compounds H Zell.	266
125	The electron microscope. Haine &	165
96 74	Inger Nov. 13 The electron microscope. Haine & Cosslett Oct. 2 The encyclopedia of spectroscopy. Ed. by G. L. Clark Mar. 6 Engineering management 2nd ed. S. A. Robertson.	176
163	by G. L. Clark Mar. 6 Engineering management 2nd ed. S. A. Robertson Aug. 21 Fatty acids, their chemistry, properties, production and uses. Pt 1, 2nd ed. K. S. Markley Nov. 12 Puel cells—power for the future. Fuel Cell Research Associates Feb. 20 Gas and air compression machinery.	179
103	ed. K. S. Markley	289
151	Cell Research AssociatesFeb. 20 Gas and air compression machinery.	216
*82	Gas chromatography-1960 Ed by	164
104	R. P. W. Scott June 12 Handbook of fluid dynamics. Ed. by	304
54	Handbook of fluid dynamics. Ed. by V. L. Streeter	162 182
72	and electricity. Vols. I & II. Edmund Whittaker	187
72	Whittaker Jan. 23 Industrial instrumentation. F. C. Tyson, Jr. Dec. 11 Information retrieval and machine translation. Pt. I of two parts. ed. A. Kent Nov. 27 Isotone effects on reaction rates. Large	232
*97	translation. Pt. I of two parts. ed. A. Kent	161
88	MelanderFeb. 20	215
74	The scientists	265 195
76	The McGraw-Hill encyclopedia of science and technology 15 vols.	
34	The optimal design of chemical re-	265
46	ne McGraw-Hill encyclopedia of science and technology 15 vols. Ed. by W. H. Crouse, et al., Feb. 6 and the cortinal design of chemical recors. R. Aris	162
89 •7	H. F. Payne	306
22	try, Vol. I, Pts. III & IV, 3rd ed.	216

*107

*163

•7

X	to	Vol.	68, .	Janu	ary	to	Decer	nber
	DI.	-11 1	0		-		Dutter	
	Pol	vmerie	mato	riale	Wind	ing	Buttre, June 1 & Hiat	2 305
	Thei	maintag					Sept.	4 199
	V	Osnovy B. J	offe	oizvods	tva	V0	Apr. 1	239
	Pro	oust & ceeding	othe gs of	rs	terna	ions	doroda) Apr. 1 A. S June 2 al Clear ciety fo Apr.	6 180 n
	AC	ir Con lean /	ferenc Air	e. Na	tional	So	ciety fo . Apr.	r 3 202
	Pro	Ed.	by F.	A. Co	tton.	mist	Mar. 2	214
	Rus	ehnica	l book	shelf)	Buy	ton	Apr. Vol. Mar. 20 of 196; Dec. 2: & Jack	125
	Scie	n	Russia	in. J.	W.	Pe	Apr. 1	228
	Sep	d aration	proc	esses	in pr	acti	Apr. 1' rry 2nd Apr. 1' ce. Ed June 1: r	7 238
	Ser	y R. F vomech	. Char	s. P.	L. Ta	iylo	June 1: June 20	304
	Sov	iet res	carch.	in c	atalys	sis.	6 vols	
	The	struct	ure of	glass	, Vol.	2.	Aug. 21 Various	180
	Tec 8,	Pt. 1	of or	rganie stigat	cher ion o	nist f ra	ry, Vol	i
	S.	L. Fr	iess &	other	etion	8.	Dec. 11	232
	Tre	d. by (adoff n anal	& Rei	nhold	istr	May 15	222
	K	ol. 2—j olthoff	pages & otl	811-13 hers	08. F	d.	Aug. 2 Various Aug. 5 ry. Vol. 1 tles and Ed. by Dec. 11 devices May 15 y. Pt. 1 by I. M. Aug. 21 istry—a three istry of Elving Nov. 12 applica-	178
	Trea	atise ompreh	ensive	alytic	al el	iem	istry—a	
	11	ie elem	ents.	Ed. K	oltho	ff &	Elving	292
	Ultr	nsonica ons. O	and I. I. I	its in Babiko	dustri v	ial 	applica- Sept. 18	257
	Visc 19	oelasti 61. J.	D. Fe	perties rry	of	pol	May 29	144
124	Zon	L Pa	arr	nd a	n ha	tee.	Nov. 13 applica- Sept. 18 ymers— May 29 hniques. July 24 d in air d in air brick— Feb. 20	195
Pi	at	2,5001 -Mulli	F	ded c	rund	use	May 29	56
	Com	alumon	Rub w's no	her's ew ca	buta	dier	e unit	
	Cycl	ic C-	T. I 8 hyd	I. Arn	old, a	Jr -t we	ocess— Oct. 39 more July 10	*90
Di	nvi	ratex	111 (comme	retat	di	Inly 94	8.4
Bt	ityl be	lithiu	m sur	spende dled	d in	w	ax can lune 12	110
				C				
Ca	Cha	ations rts gi	ve ve	ssel 1	veigh	t	Jackson	
	CE	Refres	her	iee u	nder		Jackson June 12 hemical Jibrium	*258
1	Com	bustion	tables	ambe	r L. Po	equi	librium . Aug. 7 Villiams	133
1	Cont	rol m	athem	atics.	T. J	. W	illiams	*103
1	Cum th	ulative er ap	-sum plicati	on. \	chart: V. C	s fi	Jan. 9 nd fur- dayhew June 26	
1	Cut-	out sli	de ru	le sol	ves S	tok	lune 26 e's law	*142
1	Esti	mating	nir-eo	alod o	rost	ma	e's law (P.N.) Nov. 27 s. Mur-	*136
1	th Eval	a & Fr	iedma ieat e	nxchan	ger (oef	Feb. 6 licients. dar. 20	*99
	J. Graj	F. Fra	met)	table) iod	conve	rta	lar. 20 mole	*161
•	Gran	ohical ean val	methe	Atallal od fit Heine	ds l Lani	v.). oga dot	mole Apr. 17 rithmic (P.N.)	*200
	irar	hical	metho	d for	sho	win	(P.N.) June 12 g four	*254
•		riables.	W.	A.			(P.N.)	*134
		hical	predic	tion o	ftor	n	(P.N.) Oct. 30	104
(tre	hical :	P. J	Ho	rvath	nary	tables)	*159
-	tre	pes.	P. J	Ho	rvath	nary	tables)	*159
1	irap H. How	hs car E. So many	P. J reve chweye batch aph. C	al pro	rvath ject ould lendri	fear S you	tables) Mar. 20 sibility. ept. 18 plan? Dec. 11	*159
,	Irap H. How How ret	opes. the car E. So many nomogr to figur ical pl	P. J n reve chweye batch caph. C are tra- ates. A	al prostruction of Ho al prostruction of the Ho al prostruction of the Holling of	rvath ject ould lendri inits urowi	fea S you x fror	tables) Mar. 20 sibility. ept. 18 plan? Dec. 11 n theo- (chart)	*159 *175 153
1	Irap H. How How ret	opes, ohs car E. So many nomogr to figu ical pl	P. J a reve chweye batch caph. C are tra- ates. A	al properties shown in the second state of the	rvath ject ould lendri inits urowi	fear S you x fror	mar. 20 mar. 20 mar. 20 mar. 20 mar. 20 mar. 18 plan? Dec. 11 mar. (chart) July 10 meney	*159 *175 153
1	Grap H. How Flow ret I. Kine D.	opes. ohs car E. So many nomogr to figu ical pl ection— G. Sign tic plo B. Bu	P. J n reve chweye batch caph. C ure tra- ates. A -find norini ts aid urkhar	al proper shall be sh	rvath oject ould lendri inits urowi um	fear 	tables) Mar. 20 sibility. ept. 18 plan? Dec. 11 n theo- (chart) July 10 quency. Mar. 6 rations. tables) une 26	*159 *175 153
1	Grap H. How Flow ret I. Kine D.	opes. ohs car E. So many nomogr to figu ical pl ection— G. Sign tic plo B. Bu	P. J n reve chweye batch caph. C ure tra- ates. A -find norini ts aid urkhar	al proper shall be sh	rvath oject ould lendri inits urowi um	fear 	tables) Mar. 20 sibility. ept. 18 plan? Dec. 11 n theo- (chart) July 10 quency. Mar. 6 rations. tables) une 26	*159 *175 153 139 *138
1	Grap H. How ret nspe I. Cine D. dult tio	chs can E. Sc many nomogr to figu ical pl ection— G. Sig tic plo B. Bt icompo ns—rej erical	P. J revee batch caph. Corrections ire tra- ates. A -find norini- its aid norkhar nent port. R mathe	al profits the state of the sta	rvath ject ould lendri inits urowi um ytic harts lation laddo	fear fear S you k fror ec free & ch	razeo- tables) Mar. 20 sibility. ept. 18 plan? Dec. 11 a theo- (chart) July 10 juency. Mar. 6 ations. tables) une 26 alcula- Dec. 11	*159 *175 153 139 *138
1	Grap H. How ret nspe I. Cine D. dult tio	ppes, this car E. Sc many nomogr to figu ical pl ection— G. Sign tic plo B. Bt icompo ns—reperical gineers, cles) erical sn equa	P. J n reve chweye batch caph. C tree trae ates. A -find norini ts aid norkhar nent nent D. I.	al proper shape of the shape of	ould lendrinits urowinarts lation laddo s for they	fean S you x fror eec ch (ch ch	tables) Mar. 20 sibility. ept. 18 plan? Dec. 11 a theo- (chart) July 10 quency. Mar. 6 ations. tables) une 26 alcula- Dec. 11 temical arts & Feb. 6 onduc- tables)	*159 *175 153 139 *138 *115 127 *101
1 1 2	Grap H. How ret inspe I. Cine D. Mult tio Vum enitable table tio Static	ppes, this car E. Sc many nomogr to figu ical pl ection— G. Sign tic plo B. Bt icompo ns—reperical gineers, cles) erical sn equa	P. J n reve chweye batch aph. C cire tra- ates. A -find norini its aid irkhar nent oort. R mathe. D. I	al profits ships and ships all profits ships and ships all profits all profits all profits and ships all profits a	rvath ject ould lendri inits urowi um ytic harts lation laddo s for itley Luk utatiss	feanS youxfror coper & J. c. ch (ch	razeo- tables) Mar. 20 sibility. ept. 18 plan? Dec. 11 n theo- (chart) July 10 nuency. Mar. 6 ations. tables) une 26 alcula- Dec. 11 temical arts & Feb. 6 onduc- tables) Jan. 9	*159 *175 153 139 *138 *115 127

Tables speed viscosity conversion. W M. Underwood (tables)Aug. 21 Canada—Chemical and oil industries seek	11
better trade balance (N)May 23 Caprolactum—toluene-based route chal- lenges cyclohexane for economy (N)	5
Carbon-Cyclic C-8 hydrocarbons-two	*9:
July 16	
Overseas markets spur carbon black	
growth—demand, capacity, produc- tion (chart & tables) (N)June 26 United Carbon France S. A. entry spurs carbon black boom—flowsheet	16.2
Carbon Dioxide—Liquid CO: system for	*85
Chemetron (N)Oct. 2 Casting—Monomer casting permits fabri-	5.5
cation of large nylon parts (N) Sept. 4 Catalysts	*7:
Benzoyl peroxide paste disperses quickly	55
7	*105
Catalyst outperforms vanadium in	
gets U. S. tryout in magnetizing-	
California approval (N)Apr. 3 Fluid catalytic gracking units—third-	*88
reasting tests (chart) (N)Oct. 20 Catalytic numflers for anto fumes seek California approval (N)Apr. 3 Fluid catalytic cracking units—third- generation design (N)June tz Hydeal, catalytic hydrodealkylation precess, produces first petrochemical anaphthalene—flowshectMay 1 Kinetic plots aid catalytic operations. D. B. Burkhardt (charts & tables)	104
naphthalene—flowsheetMay 1 Kinetic plots aid catalytic operations. D. B. Burkhardt (charts & tables)	*70
Colontide Designate new cotalisat man	1110
make ortho-xylenc a major phthalic feedstock (N)	48
able Aug. 7 Caustic Soda—World production in 1959	80
Collules	19 9
Cyanocthylation with acrylonitrile—market prospects (table) (N). Sept. 4 Grafted cellulose dissolves easily in common alkalis	*83
Cements, called Astroceram, for high-	
temperature scaling May 29 Lightweight cement cuts floor topping installation costs	*54
Ceramics Ceramics for resistance to corrosion, erosion. M. F. Kiachif (tables)	****
Ceramics offer hope for containing plasma in MHD units (N)July 24	70
metals now in limited production Aug. 21	*150
Refractory oxides to pace ceramics growth (table) (N)July 24 Spun ceramic fiber is heat-resistant	78
Spun ceramic fiber is heat-resistant Feb. 6	64
Chelation — Metal-complex formation: new data. A. E. Martell (charts & tables)	*95
Chem Show Complete guide	*321
attention (N) Dec. 25	*38
Complete guide Nov. 13 New equipment and materials vie for attention (N) Dec. 25 Chemical Engineering—The new chemical engineering—see under Engineering—Conference on the New Chemical Engineering.	
"Chamical Engineering?	
Conference to evaluate methods for petrochemical plant management coming (N) Dec. 11 New Trends in Chemistry Conference	82
New Trends in Chemistry Conference see under Chemistry.	02
New Trends in Chemistry Conference see under Chemistry. Will participate in NIDM Disaster Control Conference Mar. 6 "Chemical Engineering Cost File" 48, 49 & 50 Cost-capacity data. Berk & Haselbarth. Jan. 23-161; Feb. 29 Mar. 20	142
48, 49 & 50 Cost-capacity data. Berk & Haselbarth. Jan. 23-161; Feb. 20 Mar. 20	*174 *132
51. Hydraulic presses. R. O. Bathiany (chart)	194
Mendel (tables)	190
chart of the control	262 166
55 Control and relief values P C	137
to Delivertee Observation Aug.	158
Krusen Sept. 4 57. Pump and compressor costs. Oct. 2 58. A. C. electric motors. William	128
Situitian	140
Liptak Nov. 27 60. Process-vessel protectors. B. G.	140
59. Process-control instruments. B. G. Liptak Nov. 27 60. Process-vessel protectors. B. G. Liptak Dec. 25 "Chemical Engineering Refresher" Review principles of distillation. Coates & Pressburg (charts)	104
Review principles of distillation. Coates & Pressburg (charts)	

МΙ

Star di Stre co Syst Sc Conce Bee h; Tab

Conta
Bot
n
Fla
Z
&
Conti
Bi
Contr
Aut

CE S COI a COI t Cui

Dry 8 t Fiv t Ma

Pro

Pt Pro Re Ste

Tr Copy Co

Analyze material and heat balances for continuous distillation. Feb. 20 *145	_		
for continuous distillation Feb. 20 145	Petrochemicals: what's ahead-report.	Chromizing-chromium-diffusion coat-	
How to analyze the calculations for	R. A. Labine (charts & tables) Sept. 4 *1	ing turns large steel plate into "stainless" (charts & tables) Mar. 20 Concrete gets "trowelable" coating	•15
batch rectification in tray columns Jan. 23 *131	Space program offers big opportunity (N)	Concrete gets "trowelable" coating with Carboline's spray-gun (table)	-
How to make distillation calcula-	Survey of construction spending 1960-	Jan. 9	*13
tions	61 (table) (N)Apr. 3 1 Chemistry	.06 Daran latex, a vinylidene copolymer July 10	
tion columns	The new chemistry-Conference on the	Diffusion coatings modify metal sur-	
mass. Coates & Pressburg (charts)	New Chemical Engineering papers Jan. 12 144, 1	47 Du Pont's urethane floor finish, Imron	11
mass. Coates & Pressburg (charts) Pt 1 May 29 *95, Pt 2 June 26-131, Pt 3	New Trends in Chemistry Conference	Epoxy lacquer Dec. 25	7
Transport phenomena. L. D. Smoot	26-72, Aug. 7 *74, Aug. 21 *74, Sept.	Epoxy-rubber paint applies easily, re-	
(tables) Transport phenomena can simplify	New Trends in Chemistry Conference coming May 29-7, June 12 '102, June 26-72, Aug. 7 *74, Aug. 21 *74, Sept. 4-40, Sept. 18 *78Oct. 1 New Trends in Chemistry Conference	54 flects heatFeb. 20 Fire-foiling intumescent coating	
Transport phenomena can simplify transfer theoriesAug. 21 127 Derive your own transport equations	Papers Catalysis. Vladimir Haensel. Nov. 27 *1	Oct. 16 Oct. 16 Oct. 16	•11
Sept. 18 183 Estimate transport coefficients	Chemical kinetics—expanding field.	makes fabrics corrosion-resistant	
Oct. 16 187	Martin KilpatrickOct. 30 °1 High-pressure chemistry. R. H. Wentorf, JrOct. 16 °1		
Deriving transport phenomena applications			7
'Chemical Engineering Reports' Batch distillation of binary mixtures.	istry. J. L. MargraveOct. 16 *1 Inorganic-polymer chemistry points		4
Benjamin Block (charts) Feb. 6 787-98	way to high-temperature plastics.	resistanceOct. 16	*22
Calculations for multicomponent dis- tillation. R. M. Maddox. Dec. 11 127-142 Cloudy but clearing: CPI forecast for	G. Barth-WehrenalpOct. 30 *1 Ion-exchange resins and membranes.	vinylidene chloride coating. Dec. 25	4
Cloudy but clearing: CPI forecast for	H. P. GregorDec. 25 Irreversible thermodynamics, R. J.	Plastic pipe-coating becomes big business	•14
Disaster control—Plan in advance for	Tykodi	Polybutadiene film protects insides of tin cansJuly 24	8
disaster control, expert panel says Aug. 7 *111-125	A. E. Martell (charts & tables)	Polyester isocyanate copolymer resists	
Electrical safety guide to hazardous	Non-aqueous solvent systems. Katz	Polymeric coating protects ore stock-	
& tables)July 10 *123-138	& SheftNov. 13 *2	piles from weatherMar. 20 Refractory coatings prevent oxidation	10
Electrical safety guide to hazardous process areas. R. W. Scott (charts & tables) July 10 *123-138 How to appraise capital investments. J. W. Hackney (charts & tables)	lenge. H. A. Pohl Oct. 30 1 Progress in high-polymer science. Mark & Atlas (tables) Dec. 11 1	Silicone mold coatings improve inget	17
Inventory—semiannual inventory of	Mark & Atlas (tables)Dec. 11 1	surface qualityJan. 9 Slippery surfaces acquire sure-grip	6
new plants and facilities	P. Y. YengDec. 25	g7 with epoxy adhesive	•6
Apr. 17 167-176, Oct. 16 191-202 Inventory—semiannual inventory of	Solid-state chemistry gives insight	Spray gun appnes plastic and rein-	
new processes and technology Jan. 23 121-130, July 24 125-134	into crystal behavior. F. V. SchossbergerNov. 13 *2	Oct. 16 Stack coating protects against acid-	•22
Petrochemicals: what's ahead. R. A. Labine (charts, tables, maps)	Chlorinated polyether. Penton, pro-	laden fumesAug. 7	8
Sept. 4 *113-130	Chlorinated polyether, Penton, pro- duced at Hercules Powder—flow- sheet Jan. 23 *1	Teflon coatingsJune 12 Tipox resins make long-lived coat-	11
Process control. Danatos & Schall (charts & tables)June 12 *187-238	Huels perchloroethylene process	Vacuum encausulation handles wide	5
Pt 1 Principles Dollar thinking in process control.	achieves 70% conversion (N)Jan. 9 *1	2 range of particle sizes (N) New 97	*5
W. C. SchallJune 12 189 Analysis of fluid-system dynamics.	French oxidation process solves waste	Zine coatings for hot-dip galvanized products—manual offeredMay 15	19
A. R. PeckJune 12 193	Tank truck eases highway shipping	Zinc dust improves polyethylene coatings. N. E. Wilson (P.N.)Feb. 20	17
A. R. PeckJune 12 193 Progress in plant measurements. W. H. Howe & othersJune 12 199	Titanium heat exchangers replacing	ings. N. E. Wilson (P.N.)Feb. 20 Colloids—Zeta potential: new tool for water treatment. T. M. Riddick	
G. W. PlantJune 12 205	glass for chlorine cooling (table) July 24 *17	(charts)	*14
Process dynamics by pulse testing.	World production hits new high;	Combustion-Equilibrium in combustion	
Pt 2 Components June 12 213 Rocket propulsion. F. J. Hendel		chambers (chart & tables). R. L. Peters	13
(charts & tables)	all its original role in Munich—flow- sheet. T. P. ForbathJune 12 *18 Chlorotrifluoroethylene can be made	Communications	
		O Disaster control program requires get-	
Chemical rocket-propulsion systems Mar. 6 *99-114	Chlorotriffuoroethylene can be made	Disaster control program requires get- ting word to right people—report	•10
Mar. 6 *99-114 Advanced rocket propulsion	Chromium—Chromizing with Alloy Sur-	Disaster control program requires get- ting word to right people—report Aug. 7 ' Telephone conversation travels on a	•12
Mar. 6 *99-114 Advanced rocket propulsion Apr. 3 *131-148 Exotic rocket-propulsion systems	transparent Sept. 4 School Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables)	Disaster control program requires get- ting word to right people—report Aug. 7' Telephone conversation travels on a light beam via optical masers (N)	•12
Advanced rocket propulsion Apr. 3 *131-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing. R. M. G.	transparent Sept. 4 Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables) Mar. 20 Citric Acid—Bzura enters citric acid	Disaster control program requires get- ting word to right people—report Aug. 7' Telephone conversation travels on a light beam via optical masers (N) Mar. 6 Compressors	*12
Mar. 6 *99-114 Advanced rocket propulsion Apr. 3 *131-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing, R. M. G. Boucher (charts & tables). Oct. 2 *83-100	transparent Sept. 4 Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables) Mar. 20 Citric Acid—Bzura enters citric acid	Disaster control program requires get- ting word to right people—report Aug. 7' Telephone conversation travels on a light beam via optical masers (N) Mar. 6 Compressors CE Cost File 57: Pump and com- pressor costs	*120 *70
Mar. 6 *99-114 Advanced rocket propulsion Apr. 3 *131-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing, R. M. G. Boucher (charts & tables). Oct. 2 *83-100	transparent Sept. 4 Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables) Mar. 20 *18 Citric Acid—Bzura enters citric acid picture—flowsheet Apr. 3 *12 Clarifier design from laboratory data—Conway & Edwards (charts & tables)	Disaster control program requires get- ting word to right people—report Aug. 7' Telephone conversation travels on a light beam via optical masers (N) Mar. 6 Compressors CE Cost File 57: Pump and compressor costs	•70 128 250
Mar. 6 *99-114 Advanced rocket propulsion Apr. 3 *131-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing, R. M. G. Boucher (charts & tables). Oct. 2 *83-100	transparent transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables into "stainless" (charts & tables) Citric Acid—Bzura enters citre—ad picture—flowsheet the products—flowsheet Conway & Edwards (charts & tables) Sept. 18 Clay—Attapulgite products—flowsheet	Disaster control program requires get- ting word to right people—report Aug. 7' Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and com- pressor costs	•70 128 250
Mar. 6 *99-114 Advanced rocket propulsion Apr. 3 *131-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100	transparent transparent transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) tric Acid—Bzura enters citric picture—flowsheet transparent transparent stainless" (charts & tables) tric Acid—Bzura enters citric picture—flowsheet transparent stainless" (charts & tables) transparent transparent stainless transparent stain	Disaster control program requires get- ting word to right people—report Aug. 7' Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and com- pressor costs	•70 128 250
Advanced rocket propulsion Apr. 3 *131-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Aerosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212	transparent transparent transparent transparent transparent transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric acid plature—flowsheet Clarifler design from laboratory data— Conway & Edwards (charts & tables) Sept. 18 Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and	Disaster control program requires get- ting word to right people—report Aug. 7' Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117
Advanced rocket propulsion Apr. 3 *131-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Aerosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212	transparent transparent Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric acid picture—flowsheet Clarifler design from laboratory data— Conway & Edwards (charts & tables) Sept. 18 Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires get- ting word to right people—report Aug. 7; Telephone conversation travels on a light beam via optical massers (N) Compressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93
Mar. 6 *99-114 Advanced rocket propulsion Apr. 3 *131-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Aerosol precipation. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F May 15 *178 Brown, Patricia L Aug. 7 *144 Housen. Olaf Aug. 7 *144	transparent transparent Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric acid picture—flowsheet Clarifler design from laboratory data— Conway & Edwards (charts & tables) Sept. 18 Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires get- ting word to right people-report Aug. 73 Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93
Mar. 6 *99-114 Advanced rocket propulsion Exotic rocket-propulsion Bystems July 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Aerosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212 hemical Engineers Biinzler, Glenn F. May 15 *178 Brown, Patricia L. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Slowter, Edward E. May 1 *104 hemical Industry	transparent transparent Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric acid picture—flowsheet Clarifler design from laboratory data— Conway & Edwards (charts & tables) Sept. 18 Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires getting word to right people—report Aug. 7 to Telephone conversation travels on a light beam via optical masers (N) Mar. 6 Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93
Mar. 6 *99-114 Advanced rocket propulsion Apr. 3 *131-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Aerosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212 hemical Engineers Biinzler, Glenn F. May 15 *178 Biown, Patricia L. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Slowter, Edward E. May 1 *104 hemical Industry Canada's oil and chemicals aim for better trade balance (N). May 29 *50	transparent Sept. 4 Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables 18 Citric Acid—Bzura enters citric acid picture—flowsheet Apr. 3 Clarifier design from laborator dates Conway & Edwards (charts & Sept. 18 Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale — Converse of the sept. 13 Compressors—get good cleaning with ground tutshelia Nov. 13 Compressors—water injection solves dirty-gas problems in centrifugal compressors. John Schildwachter Nov. 13 **Sept. 49 **Cleaning** **Cleaning** **Alkaline solvent removes rust and heavy scale — Nov. 13 **Compressors—water injection solves dirty-gas problems in centrifugal compressors. John Schildwachter Nov. 13 **Compressors—Solvent — Nov. 13 **Compressors—Nov. 13 **Compressors	Disaster control program requires getting word to right people-report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93 *254 *106
Mar. 6 *99-114 Advanced rocket propulsion Apr. 3 *137-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Aerosol precipation. Oct. 2 *84 Pt III Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F	transparent Sept. 4 Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables) Citric Acid—Ezura enters citric acid picture—flowsheet Apr. 3 Clarifler design from laborators & tables) Conway & Edwards (charts & tables) Conway & Edwards (charts & tables) Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires getting word to right people-report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93 *254 *106
Mar. 6 *99-114 Advanced rocket propulsion Apr. 3 *137-148 Exotic rocket-propulsion systems July 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Aerosol precipation. Oct. 2 *84 Pt III Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric acid plicture—flowsheet Clarifier design from laboratory data— Conway & Edwards (charts & ables) Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires getting word to right people-report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93 *254 *106
Mar. 6 *99-114 Advanced rocket propulsion Exotic rocket-propulsion Exotic rocket-propulsion Apr. 3 *131-142 By 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Acoustic defoaming. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *86 Pt II Acoustic defoaming. Oct. 2 *89 Pt IV Rocket propulsion C. 2 *99 Where standards stand. R. V. Hugh- son Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) face process turns large steel plates into "stainless" (charts & tables) ficture—flowsheet picture—flowsheet picture—flowsheet formation of the picture—flowsheet picture—flowsheet picture—flowsheet flowsheet	Disaster control program requires get- ting word to right people—report Aug. 7; Telephone conversation travels on a light beam via optical masers (N) Compressors E C Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93 *256 *106 48 *121
Mar. 6 *99-114 Advanced rocket propulsion Exotic rocket-propulsion Apr. 3 *131-142 By the systems of the sy	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) face process turns large steel plates into "stainless" (charts & tables) fictire Acid—Bzura enters citte and picture—flowsheet	Disaster control program requires get- ting word to right people—report Aug. 7: Telephone conversation travels on a light beam via optical massers (N) Compressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93 *256 *106 48 *121 *97 *46
Mar. 6 *99-114 Advanced rocket propulsion Exotic rocket-propulsion Apr. 3 *131-142 By the systems of the sy	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) face process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric picture—flowsheet conway & Edwards (charts & tables) Conway & Edwards (charts & tables) Sept. 18 Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires get- ting word to right people—report Aug. 7: Telephone conversation travels on a light beam via optical massers (N) Compressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93 *256 *106 48 *121
Advanced rocket propulsion Exotic rocket-propulsion Systems July 24 135-142 Ultrasonics in processing July 24 135-142 House July 24 135-142 Ultrasonics in processing July 24 135-142 House July 24 135-142 House July 24 135-142 Pt II Acoustic defoaming. Oct 2 296 Pt III Acoustic derying. Oct 2 297 Pt IV Rocket propulsion. Oct 2 297 Where standards stand. R. V. Hughson. Nov 13 *201-212 hemical Engineers Blinzler, Glenn F. May 15 *178 Hown, Petricia L. Aug. 7 *144 Slowter, Edward E. Aug. 7 *144 Slowter, Edward E. May 1 *104 hemical Industry Canada's oil and chemicals aim for better trade balance (N). May 29 Capital investments—how to make sound appraisals—report. J. W. Hackney (charts & tables). May 15 Capital spending clipped, but still growing. Alfred Liwak (tables) Nay 15 Gapital spending pace quickens for 1962 (tables) (N). Dec. 11 Chemical spending advances cautiously (tables) (N). May 15 Telemical spending advances cautiously (tables) (N). May 15	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) Clarifier design from laboratory data— Conway & Edwards (charts & tables) Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires getting word to right people-report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97
Mar. 6 *99-114 Exotic rocket-propulsion Apr. 3 *131-148 Exotic rocket-propulsion Systems July 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Acrosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) face process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric picture—flowsheet conway & Edwards (charts & tables) Conway & Edwards (charts & tables) Sept. 18 Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires getting word to right people-report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93 *256 *106 48 *121 *97 *46
Advanced rocket propulsion Exotic rocket-propulsion Systems July 24 *135-142 Ultrasonics in processing R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt. I. Aerosol precipation. Oct. 2 *93 Pt. IV. Rocket propulsion oct. 2 *93 Pt. IV. Rocket propulsion. Oct. 2 *97 Pt. IV. Rocket propulsion. Oct. 2 *97 Pt. IV. Rocket propulsion. Oct. 2 *97 Where standards stand. R. V. Hughson Nov. 13 *201-212 hemical Engineers Bilinzier, Glenn F May 15 *178 Brown, Patricia L Aug. 7 *144 Hougen, Olaf Aug. 7 *144 Hougen, Olaf Aug. 7 *144 Hougen, Olaf May 1 *104 hemical Industry Canada's oil and chemicals aim for better trade balance (N) May 29 Canada's oil and chemicals may 15 *150 Capital investments—how to make sound appraisals—report. J. W. Hackney (charts & tables) May 1 *145 Capital spending clipped, but still growing. Alfred Litwak (tables) (N) Jan. 9 Capital spending pace quickens for 1962 (tables) (N) Dec. 11 Chemical spending advances cautiously 74 CPI forecast or '61: cloudy but clear-ing—enort Jan. 9 CPI looks at equipment leasing. Herbert Popper Aug. 21 *136	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric acid plicture—flowsheet Clarifier design from laboratory data— Conway & Edwards (charts & ables) Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires get- ting word to right people—report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97
Advanced rocket propulsion Apr. 3 *131-142 Exotic rocket-propulsion Apr. 3 *131-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Aerosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F. May 15 *178 Blrown, Patricia L. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Slowter, Edward E. May 1 *104 hemical Industry Canada's oil and chemicals aim for better trade balance (N). May 29 Capital spending charts & tables). May 15 Capital spending clipped, but still growing. Alfred Litwak (tables (N). 262 Capital spending pace quicks of 1962 (tables) (N). Dec. 11 Chemical spending pace quicks of 1962 (tables) (N). May 15 Capital spending pace quicks of 1962 (tables) (N). Mec. 17 Chemical spending advances cautiously (tables) (N). May 15 Capital spending pace quicks of 1962 (tables) (N). May 15 Capital spending pace quicks of 1962 (tables) (N). May 15 Cept Iooks at equipment leasing. Herbert Popper Aug. 21 CPI Mosk at equipment leasing. Herbert Popper Aug. 21 CPI my face stiffer water pollution	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric acid picture—flowsheet Larifier design from laboratory data— Conway & Edwards (charts & tables) Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires get- ting word to right people—report Aug. 7: Telephone conversation travels on a light beam via optical massers (N) Compressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97 *46 72 *68
Advanced rocket propulsion Exotic rocket-propulsion Apr. 3 *131-142 Exotic rocket-propulsion Systems July 24 *135-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Acrosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F. May 15 *178 Brown, Patricia L. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Slowter, Edward E. May 1 *104 hemical Industry Canada's oil and chemicals aim for better trade balance (N). May 29 Capital spending charts & tables) May 15 Capital spending clipped, but still growing. Alfred Litwak (tables) N, 145 Capital spending pace quick as 6 Capital spending pace quick as 6 1862 (tables) (N). Dec. 11 Chemical spending pace quick as 6 Chemical spending pace quick as 6 1962 (tables) (N). Dec. 11 Chemical spending advances cautiously (tables) (N). May 15 Capital spending pace quick as 6 CPI forceast for '61: cloudy but clearing—report	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric acid picture—flowsheet Clarifier design from laboratory data— Conway & Edwards (charts & tables) Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires getting word to right people-report Aug. 7: Telephone conversation travels on a light beam via optical massers (N) Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97 *46 72 *68
Advanced rocket propulsion Exotic rocket-propulsion Apr. 3 *131-148 Exotic rocket-propulsion Apr. 3 *131-148 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Acrosol precipation. Oct. 2 *84 Pt III Acoustic defoaming. Oct. 2 *96 Pt III Acoustic defoaming. Oct. 2 *97 Pt IV Rocket propulsion. Oct. 2 *99 Where standards stand. R. V. Hughson. Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F	transparent Sept. 4 Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric picture—flowsheet 3 Clarifier design from laboratory data—Conway & Edwards (charts & tables) Conway & Edwards (charts & tables) Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale Oct. 2 Compressors get good cleaning with ground nutshells Nov. 12 Compressors—water injection solves dirty-gas problems in centrifugal compressors. John Schildwachter Nov. 13 Compressors—water-spray keeps cylinders clean. Walter Coopey May 1 Household cleaners—liquid detergents maintain big sales lead (charts) (7) Reactor vessels cleaned with nitric "vapor". Brown & Loucks (PN.) Sulfamic acid powders remove carbonate and iron oxide scales Feb. 20 Sulfamic acid powders remove carbonate and iron oxide scales Feb. 20 Wind tunnel cleaned—professor tries plant maintenance. C. M. Loucks Sept. 18 Coal Coal Coal chemicals: on the wane (N) Feb. 20 Where will coal fit into 1975's energy picture? (chart & tables) (N) Nov. 27	Disaster control program requires get- ting word to right people—report Aug. 7: Telephone conversation travels on a light beam via optical massers (N) Compressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97 *46 *68
Advanced rocket propulsion Exotic rocket-propulsion Systems July 24 *135-142 Ultrasonics in processing July 24 *135-142 Houch Lands July 24 *135-142 Pt II Acoustic defoaming. Oct 2 *93 Where standards stand. R. V. Hughson Nov. 13 *201-212 hemical Engineers Himzler Glenn F. May 15 *178 Brown Patricia L. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Slowter, Edward E. May 1 *104 hemical Industry Canada's oil and chemicals aim for better trade balance (N). May 29 Capital Investments—how to make sound appraisals—report. J. W. Hackney (charts & tables) May 51 Capital Investments—how to make sound appraisals—report. J. W. Hackney (charts & tables) May 15 Capital spending acquickens for 1962 (tables) (N). Dec. 11 Chemical spending advances cautiously (tables) (N). Dec. 11 CPI forecast for '61: cloudy but clearing—report J. Jan. 9 CPI looks at equipment leasing. Herbert Popper . May. 21 *136 CPI: twice the size in '75 (chart N. 6) CPI: twice the size in '75 (chart N. 6) Chemical producers move Coser to consumers (N). Oct. 16 Chemical surplus seen during next	transparent	Disaster control program requires get- ting word to right people—report Aug. 7: Telephone conversation travels on a light beam via optical massers (N) Compressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97 *46 *68
Mar. 6 *99-114	transparent Sept. 4 face process turns large steel plates into "stainless" (charts & tables) steel plates of the plates	Disaster control program requires get- ting word to right people—report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97 *46 72 *68
Mar. 6 *99-114	transparent Sept. 4 Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables) 18 Citric Acid—Bzura enters citric acid picture—flowsheet Apr. 3 Clarifier design from laboratory data—Conway & Edwards (charts & tables) 18 Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale Oct. 2 Compressors get good cleaning with ground nutshells Nov. 13 Compressors—water injection solves dirty-gas problems in centifusate compressors—water-spray keeps cylinders (clean. Walter Coopey May 1 Household cleaners—liquid detergents maintain big sales lead (charts) (N) Reactor vessels cleaned with nirtic "vapor". Brown & Loucks (P.N.) Feb. 20 Sulfamic acid powders remove carbonate and iron oxide scales Feb. 20 Wind tunnel cleaned—professor tries plant maintenance. C. M. Loucks Sept. 18 Coal Coal chemicals: on the wane (N) Feb. 20 Where will coal fit into 1975's energy picture? (chart & tables) (N) Nov. 27 Coatings Aerylic coating made from nonflammable liquid July 10 Acrylic coating—chermosetting finish cures rapidly under intense infrared	Disaster control program requires getting word to right people—report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97 *46 72 *68
Advanced rocket propulsion Exotic rocket-propulsion Apr. 3 *131-142 Exotic rocket-propulsion Apr. 3 *131-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Acrosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *89 Pt II II Acoustic defoaming. Oct. 2 *89 Pt II Acoustic defoaming. Oct. 2 *89 Pt II II Acoustic defoaming. Oct. 3 *83 Pt	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citric acid picture—flowsheet Larifer design from laboratory data— Conway & Edwards (charts & tables) Clay—Attapulgite products—flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires getting word to right people-report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97 *46 72 *68 *206 *199
Advanced rocket propulsion Exotic rocket-propulsion Apr. 3 *131-142 Exotic rocket-propulsion Apr. 3 *131-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Acrosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *86 Pt II Acoustic defoaming. Oct. 2 *89 Where standards stand. R. V. Hugh- son. Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F. May 15 *178 Brown, Patricia L. Aug. 7 *144 Housen, Olaf. Aug. 7	transparent	Disaster control program requires getting word to right people-report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97 *46 72 *68
Advanced rocket propulsion Exotic rocket-propulsion Apr. 3 *131-142 Exotic rocket-propulsion Apr. 3 *131-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Aerosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *86 Pt II Acoustic defoaming. Oct. 2 *87 Pt IV Rocket propulsion. Oct. 2 *87 Where standards stand. R. V. Hugh- son. Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F. May 15 *178 Brown, Patricia L. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Hougen, Olaf. Aug. 7 *144 Housen, Claf. May 15 *018 Paramada's oil and chemicals aim for capital investments—how to make sound appraisals—report. J. W. Hackney (charts & tables). May 15 Capital spending: clipped, but still growing. Alfred Litwak (tables) (N) Jan. 9 Capital spending pace quickens for 1962 (tables) (N) Dec. 11 Chemical spending advances cautiously (tables) (N). May 15 CPI forceast for *61: cloudy but clearing—report Jan. 9 *83 CPI looks at equipment leasing. Herbert Popper. Aug. 2 *136 CPI twice the size in *75 (chart) (N) CPI twice the size in *75 (chart) (N) Chemical producers move closer to consumers (N). Oct. 16 Chemical surplus seen during next (N) Chemical surplus seen during next (N) Langare Chemicals boom. D. F. Othmer (chart) . Feb. 6 Marketers foresee profit battle (N) June 26 Marketers shift toward consumer sell- ing—T. P. Forbath's comments (N)	transparent Sept. 4 Chromium—Chromizing with Alloy Surface process turns large steel plates into "stainless" (charts & tables) Citric Acid—Bzura enters citre and picture—flowsheet Apr. 3 Clarifier design from laboratory data—Conway & Edwards (charts & tables) Conway & Edwards (charts & tables) Conway & Edwards (charts & tables) Comyessors—water injection fowheet laboratory data—Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale Oc. 2 Compressors get good cleaning with ground nutshells Nov. 13 Compressors—water injection solves dirty-gas problems in centrifugal compressors. John Schildwachter Nov. 13 Compressors—water injection solves dirty-gas problems in centrifugal compressors. John Schildwachter Nov. 14 Compressors—water-spray key cylinders clean. Walter Coopey-get (charts) (N) Compressors—water-spray detergents maintain big sales lead (charts) (N) Apr. 1 Reactor vessels cleaned with nitric "vapor". Brown & Loucks (P.N.) Sulfamic acid powders remove carbonate and iron oxide scales. Feb. 20 Wind tunnel cleaned—professor tries plant maintenance. C. M. Loucks Sept. 18 Coal Coal chemicals: on the wane (N) Where will coal fit into 1975's energy picture? (chart & tables) (N) Coatings Acrylic coating—hermosetting finish radiation and professor polises Acrylic emulsions for floor polises Sept. 4 Acrylic film protects metals, glass, plastics, leather May 15 Anticorrosion coating for pickling tank	Disaster control program requires getting word to right people-report Aug. 7: Telephone conversation travels on a light beam via optical masers (N) Compressors CE Cost File 57: Pump and compressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97 *46 72 *68 *200 *199 *101
Advanced rocket propulsion Exotic rocket-propulsion Apr. 3 *131-142 Exotic rocket-propulsion Apr. 3 *131-142 Ultrasonics in processing. R. M. G. Boucher (charts & tables). Oct. 2 *83-100 Pt I Acrosol precipation. Oct. 2 *84 Pt II Acoustic defoaming. Oct. 2 *86 Pt II Acoustic defoaming. Oct. 2 *89 Where standards stand. R. V. Hugh- son. Nov. 13 *201-212 hemical Engineers Blinzler, Glenn F. May 15 *178 Brown, Patricia L. Aug. 7 *144 Housen, Olaf. Aug. 7	transparent transparent transparent face process turns large steel plates into "stainless" (charts & tables) into "stainless" (charts & tables) Citric Acid—Ezura enters citric acid picture—flowsheet transparent enters Clarifler design from laboratory Apr. Clarifler design from laboratory & Edwards Conway & Edwards (charts & tables) Sept. 18 Clay—Attapulgite products — flowsheet Dec. 25 Cleaning Alkaline solvent removes rust and heavy scale	Disaster control program requires get- ting word to right people—report Aug. 7: Telephone conversation travels on a light beam via optical massers (N) Scompressors CE Cost File 57: Pump and com- pressor costs	*76 128 256 *117 93 *254 *106 48 *121 *97 *46 72 *68 *200 *199 *101

7

		•	
	Standard Oil distillation unit gets direct closed-loop control (N)	Stress-corrosion cracking of coppe alloys can be prevented. D. H	
	Aug. 21 *72 Stress-analysis calculations speeded by	alloys can be prevented. D. H Thompson Feb. (Corn yields maze of products at English plant—flowsheet. T. P. Forbath Mar. (6 *13
	computer program (N)Mar. 20 98 Systems engineering. T. J. Williams See under Engineering	plant—flowsheet. T. P. Forbath Mar.	h 6 *96
	Concentration	Corresion Anticorresion coating for pickling	ne .
	Beer—freeze-concentration process de- hydrates beer (N)Nov. 13 122	tanksJan.	9 •6:
	hydrates beer (N)Nov. 13 122 Table calculates change of concentration vs. time. Frank Lerman (P.N.) Dec. 25 96	Cast-stainless corn mill resists erosion corrosion	3 *260
	Concrete	passes high-temp corrosion test	C.
	Carboline's spray-gun puts "trowel-	Ceramics for resistance to corrosion, erosion, M. F. Kiachif (tables)	j
	Polyethylene film lines concrete forms	May 29	*116
	(P.N.)	(chart & table)	*188
	(P.N.) Dec. 25 100 Waterproofing agent for concrete Aug. 21 82, Oct. 30 72 Conference on the New Chemical Engineering see under Engineering		
	Construction	Copper-joining diffusion process yields stronger joints	*148
	CE Cost File see under CE Cost File "Chemosphere" house promotes plas- tics for residential structures (N)	Copper-joining diffusion process yields stronger jointsMar. 6 Copper-nickel alloy tube for feedwater heaters has high resistance (tables)	
		Diffusion coatings modify metal sur-	-114
	Construction schedules improve work. J. W. Hackney	face	116
	Costs of new plants ca. by adapting old methods (N)	Fluoro elestemen menista companiar un	*164
	Calf Coast in flurry of chemical plant	to 600 FMay 29	56
	construction (N)	to 600 F	*262
	Jan. 9 - 12	Hose—corrosion-resistant Teflon fills gap between rubber and metal. E. M. Ramberg (tables)Feb. 20	
	Multiple-contract construction — pros		*180
	(table & chart) Feb. 20 135 Navy construction brightens aluminum	rosion	*262
	picture (N)	Corrosion — first meeting hears	
	construction market (N)Sept. 18 80	world's researchersJune 12 Lead linings for process vessels. R. L. Ziegfeld (charts & tables)Jan. 23	0104
	Plastics, foams, halogens face soaring construction market (N) Sept. 18 80 Quakeproof wall built with epoxymortar Aug. 21 Sealent—bitumen rubber, low-cost caulking for joints	Magnesium in zinc improves corrosion	
	Sealent—bitumen rubber, low-cost caulking for jointsMar. 20 104	resistanceOct. 16 "Mothballing" equipment—cheap way to provide low-humidity dead stor-	*226
	caulking for joints	to provide low-humidity dead stor- age spaceSept. 4	*160
	Waterproofing agent for masonry Aug. 21 82, Oct. 30 72	New materials: better plant repairs Mar. 6	144
1	Containers	New twists for stainless-jacketed pipe	
	Bottle output tripled with new blow- molding process (N)Dec. 11 84	Pigment proves its rust-fighting prop- erties (N)	30
	Flask eliminates contamination of Ziegler catalyst components. Ford	Plastic scrubbers control air pollution.	
	& Kiss (P.N.)Aug. 7 *148	Plastic scrubbers control air pollution. F. W. Arndt (tables)Nov. 27 Plastics replace metal to update gas	*146
	molding process (N)	Plastics—polyesters differ widely in	116
•	Controls	corrosion-resistance, tests show (chart)	182
	Automatic device maintains liquid nitrogen level. B. D. Fulks (P.N.)	Further test results (chart). June 12 Refractory coatings prevent oxidation	272
		Reinforced plastics for corrosive serv-	178
	CE Cost File 59. Process-control instruments. B. G. LiptakNov. 27 140 Computers—small special-purpose	ice. R. M. Webster (charts) Pt 1 June 26 *154, Pt 2 July 10	*168
	analogs offer economies (chart) (N)	Spheres for chemical storageOct. 30 Stack and flue coating protects against	*142
	Controlling distillation columns. Bertrand & Jones. Feb. 20 Cumulative-sum (CS) charts find further application. W. C. Mayhew	acid-laden fumesAug. 7 Stainless steel jacket protects pipeline	80
	Cumulative-sum (CS) charts find fur-	insulation	*146
		Steel tanks for rocket fuels. John Halbig Dec. 25	108
	Dryer control systems—seven key spots. A. H. McKinney (charts & tables)	Halbig Dec. 25 Stress-corrosion cracking—causes and prevention (table) Apr. 17	*206
	Five technical societies discuss con-		182
	mathematics of control. 1. J. Williams	perature uses	*178
	Process control—report. Danatos &	Teflon liner repairs corroded pipe at Hanford Atomic Products. Campbell & Kingsley Aug. 7 Titanium-clad steel plate—Lukens' new process. R. V. Hughson May 15	
	Schall (charts & tables)June 12 *187 Pt 1 Principles	bell & Kingsley Aug. 7	*156
	Dollar thinking in process control. W. C. SchallJune 12 189	new process. R. V. Hughson May 15 Titanium exchangers defy chlorine	*194
	Dollar thinking in process control. W. C. Schall June 12 Analysis of fluid-system dynamics. A. R. Peck June 12 Progress in plant measurements.	(table)July 24	*170
	Progress in plant measurements. W. H. Howe & othersJune 12 199	Costs	
	Control by special-purpose ana-	Are your department's costs meaning- ful? W. H. RichardsonMay 29 CE Cost File see under CE Cost File	*108
		CE Cost File see under CE Cost File Cost engineers' meet to discuss cost-	
	ing. J. O. HougenJune 12 209 Pt 2 ComponentsJune 12 213 Process control—chemical engineers	Cost engineers' meet to discuss cost- cutting (N)	46
	must step up application (N). Jan. 23 NN	Equipment leasing eyed by CPI. Herbert PopperAug. 21 Estimate high-vacuum costs graphically C H Naundorf (charts)	*136
	Refinery uses digital computer and		
	Steam-piloted, air-controlled regulator	Evaluating quantity discounts. G. E.	*107
	L. R. Driskell (charts & tables) Nov. 13 *246	Flowsheet revision slashes maintenance	*117
	Systems engineering, T. J. Williams See under Engineering	costs (chart & table) (N)Nov. 13 Increase your plant profitability by	116
	Thermistor interface control. Fred-	decreasing capital cost. C. E. Car- roll	•113
	Trailer vans—new housing for CPI	costs by work measurement. H. J.	
C	opper		*120
	Copper-nickel alloy permits cheaper tubes for feedwater heaters (tables)	and con. McGovney & McKay (chart & table). Feb. 29 Process control report—Dollar think- ing in process control. W. C. Schall Production—estimate, words.	135
	Diffusion-bonding process for joining	Process control report—Dollar think- ing in process control. W. C. Schall	
	Copper	June 12 Production—estimate production costs	•189
	Gas reduction—Phelps Dodge's new route to copper refining (chart) (N) June 12 100	faster with summary forms. J. W. Hackney	*179
	June 12 100	Assembly construction and the II	4 1 7

10 *141 on L. 7 133

7 *120 a N) 6 *70

2 48 3. 6 *121 r 0 *97 s *46) 72 8 0

•200 *199 *101 84 *205

80

1961	\mathbf{v}
Profitability—graphs can reveal project feasibility. H. E. Schweyer (charts & tables)	*175
evaluation. W. D. McEachron (charts & tables) June 12 Pumps—Are canned pumps for you?	*239
W. T. Korzuch (chart & table) May 1	*95
costs. G. C. Lammers (P.N.) Apr. 17	196
Acrylonitrile price drop may crack huge cotton-treating market (table) (N) Sept. 4 Consumption boosted by easy-care resin	62
Finish gives better wash-and-wear	62 84
properties	01
(N) Sept. 18 Business outlook for cryogenics sketched by key men at Linde (table) (N) Feb. 20	70
(table) (N)Feb. 20	94
Aluminum from clay-production of large crystals opens way (N)May 1	•36
Freeze-concentration process dehy- drates beer (N)	122
crystal behavior. F. V. Schossberger (charts & tables)Nov. 13	•213
Aluminum from elay—production of large crystals opens way (N). May I Freeze-concentration process dehydrates beer (N)	
Vapor-phase process grows unique	*147
Cyanoethylation—Acrylonitrile price cut may accelerate commercial CN cot-	10
ton (table) (N)Sept. 4	62
D	
Decolorizing American Sugar's new automated continuous adsorption process (chart)	
Decolorizing process permits re-use of	*64
Defense—Shelters—Rohm & Hass com-	110
pletes underground shelters (N) Nov. 13 Defoaming—Acoustic defoaming—Ultra- sonics report. R. M. G. Boucher Oct. 2	114
Oct. 2 Degassing unit at Crucible Steel operates like giant vacuum coffee maker (N)	*96
Feb. 6	*48
sorber E. D. Ermenc (charts & tables)	87
Design Adsorber—Designing a fluidized adsorber. E. D. Ermenc (charts & tables)	123
batch stills for binary mixtures— report. Benjamin Block (charts) Feb. 6. Cis-polybutadiene rubber plant grafted onto styrene-butadiene line at Good- rich-Guif (chart) (N)June 26	*87
rich-Gulf (chart) (N)June 26 Controlling distillation columns. Ber-	
Controlling distillation columns. Bertrand & Jones. Feb. 29 Design and train for cold weather operations. Troyan & Threlkeld (tables)	•139
Dec. 11 Design charts, E. J. Gibbons, See under	164
Design charts. E. J. Gibbons. See under Plant Notebook, Disks—how to size safety disks. E. M. Diss & others	187
Jones, Jr. (charts)Aug. 7 Dryer control systems—seven key spots.	125
May 1	*79
Fluid catalytic cracking units—third- generation design (N)June 12 Fluid-flow distributors, D. R. Richard-	104
Heat exchangers—estimating air-cooled	*83
son May Heat exchangers—estimating air-cooled exchangers made easy. Murtha & Friedman Feb. 6 High-vacuum systems—aids to pre-	*99
	107
July 10 Non-Newtonian fluid-flow scaleup. R. L. Bowen, Jr. see Fluids	139
riant designers need better engineer- ing data from equipment makers. P. J. BaukolSept. 18	171
Radiation hazards—design: key to minimizing nuclear plant hazards. Pt 2. L. J. Cherubin	163
tables) Pt 1 Tubular reactorsMay 15 Pt 2 Packed-bed and stirred tank reactors	165 81
reactors	
3Mar. 20 •	

P Nev ein Race ir (1) Scaa R P P P P P P P

PP PP Unit (C) Engire AIC el ASI Bace '66 Chi gC Chee ir

Ch.
To Coe
e:
Coll
it
o
Cos
Cos
E:
Tyr
e:
"Er

Firm C Ger Gov in Hun tl Is to C Is

John Property John North Property John Property John North Property John Property John

Roce Sala Sala Sala Sala Sala Sala

МΙ

corrosive service. R. M. Webster (charts) Pt 1 June 26, *154, Pt 2	seek California approval (N). Apr. 3 Stack—giant self-supporting plastic	*88	(N)	3 15
July 10 *168 Risk in design—Increase your plant	stack Sent 4	#169	Tax credit proposal—good investmen	3 10
profitability by decreasing capital cost. C. E. Carroll	Ultrasonic precipitation for air pollu- tion control, gas cleaning—Ultra- sonics report. R. M. G. Boucher		incentive? (N) July 10 Thermoelectrics — sunny market for	0 *7
Sedimentation systems from laboratory	(charts & tables)Oct. 2 Water-spray clears compressors of	*84	chemicals (chart) (N)June 1: Valves—ball valves loom larger (chart	2 *0
data, Conway & Edwards (charts & tables)	stubborn dust. Walter Coopey May 1	*106	(N)Oct. 30	
See under Engineering	Olor rides synthetic fibers' rise	0.4	Editorials Designed to serveJuly 10 What do you mean, "petrochemical":	0
Defoamer douses syndet suds in seconds	(charts) (N)	84	Sept. 4	4
July 24 *82 Fuel additive prevents deposits in	olefin and acrylicsDec. 11 Water-soluble liquid effective in dyeing	90	What do you mean, "professional" July 2	4 .
combustion chambersJan. 9 60 Sales of liquid syndets soar; powders	nylon and woolDec. 25	42	Education AlChE report on dynamic objectives	
level off (charts) (N)Apr. 17 126 Die-making costs halved by new metal-	E		for chemical engineeringDec. 11 ASEE met in bluegrass stateJuly 10	1 15
plastic compoundSept. 18 Dimethyl Sulfoxide—Pulp plant pro-			Booklet gives pros and cons for taking	R
duces commercial dimethyl sulfoxide	Economics Alcohols—market battle looms for rival	-	grad workJan. 23 ChE enrollments drop; advanced de-	-
from lignin—flowsheet. M. D. Robbins June 26 *100	higher-alcohol processes (N).Dec. 11 Aluminum producers face bright dec-	70	grees rise (N)	-
Dimerization process—Humble's Aldox process yields low-cost, higher	ade, Kaiser survey shows (table) (N)Jan. 9	46	ment	k
alcohol (N)	Atom-power industry seeks cure for growing pains (N)June 12	93	them down. J. I. PetersOct. 2 Industry's aid to education is sizable	2 *11 e
Hurricane Carla proved good planning can prevent major damage (N)	Australia's CPI bouyed upward by U.S.	136	(table)June 12 Is the bachelor's a terminal degree for	2 25 r
Oct. 16 *94 Report based on experts' panel discus-	Britain's petrochemicals boom (table) (N)	58	Rocketeers spurp continuing-education	2 25
sion	Business outlook from McGraw-Hill's Dept. of Economics (N)Nov. 13	111	parley	3 24
Dies & othersSept, 18 *187 Distillation	Canada's oil and chemicals seek better		at Columbia University May 1 Ten years out? Go back to the books	1 10
Acetic and formic acids recovered from	trade balance (N) May 29 Capital investments—how to make	50	May 29	9 *10
sulfite liquor by unique process (charts) (N)	sound appraisals—report. J. W. Hackney (charts & tables) May 15	145	University of California offers refresher course for engineers Jan. 23	3 15
-report, Benjamin Block (charts)	Hackney (charts & tables)May 15 Capital spending: clipped but still growing. Alfred Litwak (tables) (N)		Egypt launches pulp-from-bagasse project (N)Mar. 20	10
Feb. 6 *87 Calculations for multicomponent dis-	Carbon black overseas markets spur	48	Elastomers Elastomers: ethylene-propylene-butyl-	_
tillation—report. R. M. Maddox Dec. 11 127	growth of U. S. capacity abroad (chart & tables) (N) June 26	62	ene copolymers—Progress in high- polymer science, Mark & Atlas	
Cascade theory in distillation. W. D. Maclean (charts) Aug. 21 123 Controlling distillation columns. Jones	Chemical marketers foresee profit battle (N)June 26	68	polymer science, Mark & Atlas (tables) Dec. 11 Fluoro elastomer resists corrosion up	0
Controlling distillation columns. Jones & Bertrand Feb. 20 *139 Graphical prediction of ternary azeo-	Chemical marketers shift toward con- sumer selling (N)Oct, 30	66	to 600 F May 29 Texin, urethane elastomer Apr. 3	9 5
Graphical prediction of ternary azeo- tropes. P. J. Horvath (tables)	CPI capital spending pace quickens	78	Acyclic unit generates direct current	
Mar. 20 *159	for 1962 (tables) (N)Dec. 11 CPI forecast for '61—reportJan. 9	*83	directly (N)	7 *5
Reflux drum design. Friedman & Mur- tha (P.N.) Jan. 23 *157, Mar. 20 *178 Review principles of distillation. Coates	CPI: twice the size in '75 (chart) (N) Feb. 6	42	ing at Sifco (N) Mar. 20 Electrostatics in the selection of dust	*9
& Pressburg (charts)	Chemical producers move closer to con- sumers (N)Oct. 16	106		
Batch distillation—How to analyze calculations for batch rectification Jan. 23 *131	Chemical spending advances cautiously (tables) (N)	74	tables)	. 10
Continuous distillation Pt. 1—Analyze material and heat balances for con-		136	news interest, H. L. Bullock (charts) Oct. 2	*10
tinuous distillationFeb. 20 *145 Continuous distillation Pt. 2—How to	decade (N)	54	Energy conference discusses producing electricity from solar energy (N))
make distillation calculations Mar. 20 *155		62	Oct. 16 Fuel cell—new sodium-chlorine system	1
Predicting tray efficiency in distilla-	Cryogenics—how's business in cryogenics? (table) (N)Feb. 20 Fuel oil finds new market in iron-	94	boosts voltage (N)June 12 Generator powered by sun's rays on	*10
tion columns	Fuel oil finds new market in iron- making (N)Oct. 30	55	thermoelectric unit (N)Oct. 16 The organic semiconductor challenge.	. •91
Shortcuts in distillation design. H. M. Jones, Jr. (charts)	German chemical industry—big market for computers (N)Aug. 7	72	H. A. Pohl (chart & tables). Oct. 30 Safety—guide to electrical safety in hazardous process areas—report. R.	10/
practice (N)	for generating facilities grows		W. Scott (charts & tables) July 19	• 122
closed-loop computer control (N) Aug. 21 *72	(charts) (N)	62	Thermoelectric generator efficiency boosted by samarium sulfide. May 1	*54
Theoretical plates with no equilibrium plot. Ferdinand Rodriguez (P.N.)	stirs U. S., Japanese interests. Helen	*42	Thermoelectricity - new developments	5
June 12 *256 Troubleshooting new equipmentPlant	Avati (chart & table) (N)May 29 Japanese chemicals boom. D. F. Oth-		Thermoelectricity slated for new re-	
startup Pt 2. J. E. Troyan Mar. 20 147 Winemaking at Roma Wine keeps age-	mer (chart)Feb. 6 Japan's petrochemicals on the move	*54	mote uses (N)	
old process current—flowshoot C R	(tables) (N)	94	cals (chart) (N)June 12 Zeta potential: new tool for water treatment, T. M. Riddick (charts)	- 34
Havichorst Feb. 6 *76 Drafting—Blackboards replace drawing boards, cut costs (N)	should stabilize erratic supply G E	82	Pt 1June 26	-121
Drugs-Research spending hits new high	Nicklaus (chart) (N) Jan. 23 Outlook—CE samples CPI crystal ball (N) Feb. 20	82	Pt 2July 10	*141
Drums	Oxygen gains in steel and chemicals	48	Electronics calls for more chemicals (chart) (N)June 12	*94
Reflux drum design. Friedman & Mur- tha (P.N.) Case 2 Jan. 23 *157, Case	markets (N)		(chart) (N)June 12 The organic semiconductor challenge. H. A. Pohl (chart & tables)Oct. 30	104
3 Mar. 20 178 Repair—epoxy repairs drums that spring leaks in transitSept. 4 162	Petrochemicals—will the Gulf Coast	*113	Pneumatic or electronic instruments?	
177 ying	yield to the East Coast? (chart &	0.4	Electrophoresis-Zeta potential: new tool	
Alumina pellets boost efficiency of gas dehydration	tables (N)	94	for water treatment. T. M. Riddick (charts) Pt 1 June 26 *121, Pt 2 July 10	+141
dehydration Sept. 18 S6 Control solids—drying equipment— seven key spots. A. H. McKinney (charts & tables)	hesives market (N)Oct. 2 Phosphoric acid—concentrated phos-	52	Elevator moves on track to change three	
(charts & tables)May 1 *79 Drying uses mass and heat transfer—	phoric acids poise for takeoff (chart & table) (N)Nov. 13	112	reactors (P.N.)Oct. 30 Encapsulation	
CE Refresher. Coates & Pressburg (charts)July 24 151	Plastics aim at metals' markets (chart & table) (N)May 1	4.4	New technique for encapsulating solids (N)	.93
Spray dryer carves chemicals out of	Polystyrene's prospects in competitive world markets (charts) (N). Sept. 4	68	Silicone encapsulant is easy to apply Mar. 20	*104
bark (N) Dec. 11 *71 Ultrasonic drying—Ultrasonics report. R. M. G. Boucher (table) Oct. 2 *97	Porosity opens new horizons for plas- tics (N)	*72	Conference on New Sources of Energy	
Dust and Fume Handling	Potash producers step up capacity to meet rising demand (charts & tables)		finds solar power most promising (N)Oct. 16	104
Air pollution control system also recovers pure nitrogen (charts) (N) Oct. 16 102	(N)Oct. 16 Profitability—graphs can reveal project	98	Industry's energy demand set to soar	
Dust filter selection depends on elec-	fongibility H E Schwever (charts &	1175	(charts) (N) July 24 Where will coal fit into 1975's energy	
trostatics. E. R. Frederick (charts & tables)June 26 *100	tables)	410	picture? (charts & tables) (N) Nov. 27 Engineering	54
Cook (P.N.)	& tables)June 12 *	239	AIChE report on dynamic objectives for chemical engineeringDec. 11	158
Monomolecular films for dust control July 10 80	exports (N)	80	Conference on the New Chemical Engi-	.00
Plastic scrubbers control air pollution. F. W. Arndt (tables)Nov. 27 *146		104	neering—papers The new chemistryJan. 12-144.	147
Smog—California refineries complete smog reduction program (N). Sept. 4 63	Space exploration fuels to get market emphasis, expert says (N)Jan. 9	44	The new mathematics. Jan. 9-95, 103. The new tools of engineering. Jan. 23	137

CPI
13 120
nd13 106
ent
10 *76
for
12 *94
rt)
30 56

71has 11 143 up 29 56 3 111

8 7 •52 y 0 •104

6 104 78

147 111 137

Hints for plant startup. J. E. Troyan		Salaries—overtime compensation for	162	Chromatograph designed for process control
Pt II Troubleshooting new equipment Mar. 20	147	exempt employeesApr. 3 Salaries—professional engineers stand	132	Circulating bath, isothermal Nov. 27 *76
Pt III More on troubleshooting new	91	tall on pay scale (tables)Aug. 21 Some myths of professional practice.		Comparator, flow rateJan. 23 *104
New tools of engineering—see Conference on the New Chemical Engineer-		S. M. Bernd	*126 *161	Compensator, expansionMar. 20 *206 Compensator, thermocoupleApr. 17 *148
ing		Strike guidelines set by NSPE. Dec. 11	162	Computer, flow-volume Dec. 25 50 Computer, memory Feb. 20 206 Computer, packaged June 12 114
Radioisotopes help solve CP1 engineer- ing problems. Overman & Rohrman		Technicians—NSPE defines certification grades of engineering technicians		Computer, memory Feb. 20 206
(tables)	•151	May 1 Ten years out? Go back to the books		Computer, packagedJune 12 114 Computer systemJune 12 116
R. L. Bowen, Jr. (charts & tables)		May 29	*102 *185	Computer system June 12 116 Control, alternator July 10 90 Control, liquid-level Mar. 20 *110
Pt 1 Designing laminar-flow systems June 12	248	Trade secrets-how the courts have de-	****	Control panel simulatorOct. 2 *68 Control, pressure-vacuumJuly 10 *90
Pt 2 Determining end of laminar re-	127	fined trade secrets. A. W. Gray Jan. 9	*120	Control, sludge pumpFeb. 20 *112
gion	147	Vacation—2 weeks in another town July 10	*152	Control system
D. 4 Designing turbulent flow sys-		What it takes to get that new job.		Control, vacuum
tems	143 129	P. J. Brennan		Controllers
Pt 6 Best methods for obtaining flow data	119	William Kulick Nov. 13	*240	Controller — indicating temperature
Pt 7 Interpreting and converting data	131	Engines Minuteman first-stage engines to get		Controller — indicating temperature controller — Sept. 18 *90 Controllers, level Apr. 3 *196, *198 June 12-118, Oct. 30 *80, Dec. 25 *122
Systems engineering. T. J. William	101	filament-wound casings (N)Dec. 25 Rocket engine, using "sectional	*32	June 12-118, Oct. 30 *80, Dec. 25 *122 Controller, multipoint
(charts & tables) Pt 12—Computer controlFeb. 6	•107	Rocket engine, using "sectional charge", gives giant thrust (N) June 12	104	Controller, pHNov. 27 78
Pt 13—Plant unit designApr. 3 Pt 14—About the futureMay 1	*149 *87	Solid-fueled engines move closer to big	*76	Controller, pH Nov. 27 78 Controller, process Nov. 13 136 Controller, proportional July 16 88
United Engineering Center dedicated		space role (N)		
(N) Dec. 11	76	fatter at Aerojet (N)Oct. 2 Enzymes—Cellulase enzyme potent over	*54	Controller, set-point Apr. 17 °2#3 Controllers, temperature Jan. 9 °152 Mar. 6 °164. Apr. 17-223, July 10 °88
AlChE report on dynamic objectives for	150	2-3 pH range and up to 160F. Feb. 20	104	NOV. 21 -18 -18
chemical engineeringDec. 11 ASEE met in bluegrass stateJuly 10	158 156	Equipment Batch stills—design and use for binary		Conveyor, drag
Bachelor degrees down, grads up, early '61 figures showDec. 11	162	mixtures-report. Benjamin Block	*87	Conveyor, drag Dec. 25 52 Conveyor, pneumatic Nov. 13 2281 Coupling, flexible June 26 177 Coupling, pipe and tube. Oct. 30 *78
ChE enrollments down; advanced de-	58	(charts)		Coupling, pipe and tubeOct. 30 *78
grees up (N)		shall and Stevens annual indexes of comparative equipment 1913-1960		Coupling, tubing
Glenn Blinzler is bothMay 15 Chemical engineers look for more help	178	(charts & table)	115	Data processing systemApr. 3 116
in finding new jobs (charts & tables)	89	Dryers—control solids-drying equip- ment. A. H. McKinney (charts &		Defoamer, sonic
Chemical engineers urged to step up	0.0	Dust filter selection depends on electro-	*79	Dehydrator
application of process control (N)	88	ututiAn E D Frederick (charts &	*100	Densitometer
Ch. E. writers beware lest humor lose	148	tables) June 26 Electrical safety in hazardous process areas—report. R. W. Scott (charts &	100	Aug. 21 88
Coexistence for design and operating engineers? W. H. Richardson.Oct. 16	110			Detector, gas densityOct. 2 160 Difference counterApr. 3 *116
engineers? W. H. Richardson.Oct. 16 Collective bargaining—professional men	*216	Filter aids—selection and use. T. M. Jackson, Jr. (table)Mar. 20	*141	Digester automatic speeds nitrogen
Collective bargaining—professional men in the middle need a sounding-board organization. R. R. StokesFeb. 6	*112	Fluid catalytic cracking units-new de-		analyses Aug. 21 *86 Discharge vent Mar. 6 86 Dispenser, liquid Nov. 13 *136
Cost engineers' meeting to discuss cost-		sign outperforms ancestors (N) June 12	104	
cutting (N)	46	Leasing-CPI looks at equipment leas-	•136	design
engineers? W. C. SchallMar. 26 "Engineermanship." Bernard Benson	166	ing. Herbert Popper Aug. 21 Linings—how to choose lead linings for		Drives, variable-speed Jan. 9 *149 Mar. 6 *166
First Inter-American Congress of	*134	& tables)Jan. 23	•164	Drum nolvethylene_steel Sept 4 *185
Chemical Engineering (N)Nov. 27	53	New equipment and materials vie for Chem Show attention (N)Dec. 25	38	Drum tumblerJuly 24 *192
German deplores Ch.E. shortage in his country	148	Plant designers need better data from		Drum stacker, tipper Jan. 9 *156 Drum tumbler July 24 *192 Dryer, bench-scale Jan. 9 *66 Dryer, compressed air Dec. 11 *212 Dryer, did.bed Nav 27 *157.
Government asks step-up in engineer- ing effortAug. 7	144	equipment makers. P. J. Baukol— with PENA's reply Sept. 18 Pumps and compressors—how to choose	171	Dryer, fluid-bed
Humanities: dust them off; don't knock		them. Younger & Ruiter (charts)		
them down. J. I. PetersOct. 2 Is the bachelor's a terminal degree for	•116	Pumps—Are canned pumps for you?	*117	Dust collectorsJan. 9-135, May 1 1 236 May 15 2316 Evaporator-stripperJuly 10 186 Extractor agitates, then separates May 1 258 May 1 358
chemical engineers?June 12 Is your eye on the executive suite?	252	W. T. Korzuch (chart & table) May 1	*95	Extractor agitates, then separates May 1 *58
W. A. Hertan	•144	Reinforced plastics for equipment in	2.0	Fan. axial
Aug. 7	140	Reinforced plastics for equipment in corrosive service. R. M. Webster (charts) Pt 1 June 26 *154, Pt 2		Feeder constant-head Jan 9 *64
Job mobility—will your next move be easy to make?Oct. 16 Job mobility survey indicates what	•204	July 10	*168	Feeder, constant-rate May 29 *62 Feeder, solution Feb. 6 *157 Feeder, swing-gate Sept. 4 *190
Job mobility survey indicates what placement help is needed (charts &			*201	Feeder, swing-gate
tables) Dec. 25 Jobs for Class of '61 ChE's come slowly	89	Trouble shooting new equipment—Hints for plant startup. J. E. Troyan Pt II Mar. 20-147, Pt IIIMay 1		Feeder, vibrating Aug. 21 175 Feeder, volumetric May 29 138 Filter, all-plastic Oct. 30 *80
(charts)	157		91	Filter, all-plastic Oct. 30 *80 Filter, belt Dec. 11 *212
Jobs more jobs ahead Dec. 11 Jobs not at stake right nowMar. 20	162	Actuators, valve. Jan. 9 *154, Aug. 21	*88	Filter, belt
Jobs-supply and demand: foggier than	124	*169, Sept. 4	.183	
Make management training count. R.		Aftercooler Mar. 8 Agitator, kettle Oct. 30 Agitator, portable Feb. 6 Agitator, removable-blade Aug. 7 Alarm, flow Apr. 17 Alarm, level May 1 Alarm rotameter June 12 Alarm scanner May 15 Analyzer, beryllium Nov. 27 Analyzer, gas Oct. 16	*78	Filter, inline Sept. 4 *186 Filter, microporous Dec. 11 *223 Filter, miniature Feb. 6 *158
P. Bott June 26 New look at engineer attitudes. May 29	106	Agitator, portable	172	Filter, nonmetaine
Northwestern University's 15th annual	156	Alarm, flow	*132	Filter-regulatorJuly 10 *88 Filter-reversible filter conquers hard-
job survey	154	Alarm rotameter June 12	*114	to-remove cakeOct. 30 *76
Number of new engineers drops. Jan. 9 Process-control men hear experts stress		Analyzer, berylliumNov. 27	76	Filtration equipmentSept. 18 90 Fittings, plastic pipeOct. 16 252
Professionalism is a two mile road W	72	Analyzer, gas Oct. 16 Analyzers, moisture Feb. 20	*212	Fittings, plastic plpe
A. CunninghamJune 26 Puerto Rico invites inter-American ChE's to autumn meeting (N)	*136	Oct. 16	120	Flowmeters May 1-128, 131, Sept. 4 86 Oct. 16 *248, Dec. 11 212
ChE's to autumn meeting (N)		Analyzer, monoxide Oct. 16 Analyzers, oxygen Sept. 18	*245	riowineter campiator
Recruiters undannted by economic cli-	68	Analyzer, oxygen—portableOct. 16	116	Flowmeter, giant magneticMay 15 *92 Flow meter, solidsJune 26 84
mate May 1 Recruiting roundelay Apr. 17 Recruiting—25 ways to better your skill	186	Autoclave	*90	Flowmeter, thermal
Recruiting-25 ways to better your skill		Automator, reactionJan. 23	*102	Cago differential Sent 4 486
Rocketeers' continuing education ses-	•192	Barrel carrier May 1 Barrel handler May 15	*99	Gage, high-pressure 17 *148, Nov. 13 *279 Gage, pressure-Apr. 17 *148, Nov. 13 *279 Gage, pressure-drop Feb. 20 *210 Gage, scanning Dec. 11 *220 Gage, tapk 7 *88
sion lacks "pull"	244	Battery, nickel-iron	*157	Gage, pressure-dropFeb. 20 *210 Gage, scanningDec. 11 *220
	*131	Belts, polyesterSept. 18	*242	Gage, tank
Salaries—EJC salary study shows pay gains (charts)	172	Blending systemApr. 3	116	Gages, thickness. Feb. 20-210, June 12 *291
gains (charts)	208	Calculator, portable	*110	Gas chromatographMar. 20 110
	252	Barrel carrier May 18	226	Gas generator
Salaries—new yardstick for measuring your pay	122	Carboy, plastic May 15 Catalyst loader Sept. 4 Cell measures gas density Oct. 30	*190	Generators—new look in steam generators
your pay Jan. 9 Salaries' new yardstick—how does your pay measure up to BLS findings?		Centrifuge—small unit works like big		Generators, nitrogen Aug. 21 167 Oct. 16 *118
(chart)Jan. 23	153	one	50	Generator, plasma arcOct. 2 162

Col Du Ea

Inv Inv

Not no Ny b

Pro M Ra:

Filtra Cha N Dua t & Em

Gla

Disseption of the control of the con

Cen to Slip no Ure

Flotal
Berrili
Berrili
V
Moio
Cc
Flows
fc
w
Flows
Alu
p
Atti
Beee
H
But
Car
ei
p
Chl
Ctl
Ctl
Cor
u
Gla
k
Hea

ΜI

Generators, thermoelectric, supply power from gas heatMar. 6 *86	Pumps, seallessJan. 9-148, Mar. 6 *87 Sept. 4 *194, Oct. 16 *120	Valve, globe angle, "Y"May 29 *124
Companies time generator performs	Sept. 4 *194, Oct. 16 *120	Valve, globe angle, "Y" May 29 *134 Valve, globe—packlessJuly 24 *190
like a giant	Pump, self-primingSept. 4 88 Pump, slurry, with two-vane impeller	Valves, heavy-duty
like a giant	Feb. 6 *70	Apr. 3 *195, June 12 *116, Sept. 4 185
	Pumps, vacuumJuly 24 *188, Oct. 2 *66	Valve, high-temperature May 29 *134
Heater, direct-fired, runs cool while	Pump vacuum-pressure Oct 2 *161	Valve, high-vacuum Dec. 11 220 Valve, indicator Aug. 7 *88
Heater	Pyrometer	Valve, instrument Oct. 36 78 Valve, level-control June 12 *116 Valve, motorized gate Nov. 27 *78 Valve, needle July 10 *186
Heater, tank	Pyrometer	Valve, notorized gate June 12 *116 Valve, motorized gate Nov. 27 *78
High-pressure equipment Mar. 20 112 Homogenizer		Valve, needleJuly 10 •186
Hot-water source—steam-water mixer Jan. 23 104	Reader, punched-tape Mar. 6 87 Readout, meter June 12 300 Receivers, pneumatic June 12 *116	Valve, plastic-lined Sept. 18 *252
Indicator, combustibles Dec. 25 52		Valves, plugSept. 4 *189, Sept. 18 *94 Valve, plug-check
Indicator, combustibles	Recorders Mar. 20 *110. Apr. 3 *116	Valve, pinch June 12 **1818 Valve, plastic-lined Sept. 18 **252 Valves, plug Sept. 4 **189, Sept. 18 **252 Valves, plug Sept. 4 **189, Sept. 18 **252 Valve, pressure-reducing Oct. 16 **252 Valve, priority relief Oct. 16 **252 Valve, priority relie
Indicator, liquid levelDec. 11 *213	Recorder, miniatureJan. 9 150	Training principles of the second
	Recorder vacuum Mar 6 •172	Valve, self-drainingJune 12 *290 Valve, shutoff July 10 *190
Torollation sight unothers form Apr 2 119	Refractometer May 1 *60	Valve, solenoid
Integrator, electronic Sept. 4 *88 Jug. polyethylene Oct. 30 *80 Kettle, melting Oct. 30 *78 Kinetics Kit (KK). May 29 *60 Lann trouble-shotting. Sept. 18 *92	Recorder, miniature	Valve, sampling Jan. 9 *00, Aug. 7 *86 Valve, self-draining June 12 *290 Valve, sblutoff July 10 *190 Valve, solenoid Mar. 6 *87 Valve, swing-check June 12 *229 Valve, tapered plug Nov 13 *280 Valve controller Dec. 11 *100 Vapor Seb. 20 *290
Kettle, melting Oct. 30 *78 Kinetics Kit (KK) May 29 *60	Regulators, pressureJune 12 *118	Valve controller Dec. 11 •100 Vapor vent
Lamp, trouble-shooting Sept. 18 *92	Regulators, pressure and flow. May 15 *212	
Liner, polyethyleneSept. 18 94 Loader, bulk-materialMay 15 212	Rotameter, high-pressureJune 12 *294	Verticone sprays liquid on flowing solids
Magnets for varied usesApr. 3 *114	Rubber dryer	Vibrators, pneumaticJune 12 *291
Kinetics Kit (KK). May 29 *60 Lamp, trouble-shooting Sept. 18 *92 Liner, polyethylene Sept. 18 94 Loader, bulk-material May 15 212 Magnets for varied uses. Apr. 3 *114 Manifold, relief valve. June 26 *176 Manometer, differential Aug. 7 84 Manometer, surgeproof Dec. 11 *217 Meter, automatic Oct. 2 *156 Meter, conductivity Aug. 21 *90 Meter, controlled Nov. 27 *156 Meter, gas Dec. 25 *120	Sampler, continuous May 29 62	Viscometer Sept. 18 *92 ViscometerOct. 16 *250
Manometer, surgeproof Dec. 11 *217 Meter, automatic Oct. 2 *156	Sampler, dust	Waste filtration plantFeb. 6 156
Meter, conductivity Aug. 21 *90	Sampler, fluid	Zone refiners Mar. 6 166, Oct. 2 68
Meter, gas	Scale, conveyorFeb. 6 70	Esters Adipate esters make PVC plasticizers
Meter, controlled Nov. 21 - 136 Meter, gas Dec. 25 - 120 Meter, humidity Oct. 16 - 254 Meter, liquid Sept. 4 - 188 Meters, moisture. Apr. 17 - 225, Dec. 11 - 100 Meter reader July 24 - 191	Regulators, pressure and flow May 15 *212	Oct. 16 114
Meters, moisture. Apr. 17 *225, Dec. 11 100	Scrubber, flooded-bedJuly 24 *92	Sucrose esters set for commercial production (N)
Meter recording pH Jan. 9 *68	Scrubbers, gas Jan. 9-68, Dec. 11 *214 Scrubber, gas—portable July 24 90 Scrubber, wet Dec. 11 *100	Ethanol—Physical properties in rapid roundup. William Shulman (table)
Meter, solids flow	Scrubber, wet	(P.N.)
MicrofilterJuly 10 189	Sifter, cooling	Ethylene copolymers from Dow and
Microfilter	Sight glass: worth looking into June 23 *100	Carbide
Mill, impact—high speedMay 15 *88	Solids-transfer device	Petrochemicals report. R. A. Labine
Mixer, batch Sept. 4 *88 Mixer, continuous Jan. 23 *177 Mixer, convertible Sept. 18 94 **** *****	Speed-reducer, lube-free Mar. 20 112 Spout and cradle for liquids containers	(charts & tables)Sept. 4 *118 Humble's ethylene storage cavern at
Mixer, convertible Sept. 18 94	Tuno 12 •300	Mont Belvieu, TexOct. 16 *108 Liquid ethylene starts regular transit
Mixer, drumJune 26 *175 Mixer has counter-rotating elements	Still, molecular	in giant refrigerated trailer (N)
Nov. 27 •74	Switch, explosionproof Sept. 18 250	Mobil Chemical's first petrochemical
Mixer has two agitators on same shaft Dec. 25 48	Switch, flow	step a big one—flowsheet, T. H.
Mixer ribbon July 24 92	Switch, limit Sept. 18 254 Switch, pressure Jan. 9 *153 Switching station on conveying system	Arnold, JrSept. 4 *106 Oxidation—Aldehyd GmbH's direct.
Mixer, solidsJuly 10 181	Switching station on conveying system	low-cost route to acetaldehyde
The state of the s	The state of the s	(-1
Mixer speeds batch blending cycle	simplifies storageOct. 16 *116 TachometerAug. 21 *172	Arnold, Jr
Mixer speeds batch blending cycle Feb. 20 *108 Mixer, stationary	simplifies storage Oct. 16 *116 Tachometer Aug. 21 *172 Tank cleaner, jet Oct. 2 *157 Tank heater, vertical Aug. 21 *90	water (N)July 10 •76
Mixer, stationary	simplifies storage	water (N)
Mixer, stationary May 29 *136 Mixer variable speed Dec. 25 *122	simplifies storage	water (N)
Mixer, stationary May 29 *136	simplifies storage	water (N)
Mixer, stationary May 29 *136	Simplifies storage	water (N)
Mixer, stationary May 29 *136	Simplifies storage	water (N)
Mixer, stationary May 29 *136	Simplifies storage	water (N)
Mixer, stationary May 29 *136	Simplifies storage	water (N)
Mixer, stationary May 29 *136	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer Stationary May 29 136	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N) July 10 *76 Explosions Electrical safety in hazardous process areas—report. R. W. Scott (charts & tables) July 10 *123 Explosion suppression: new safety tool. C. B. Hammond
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary May 29 136	Simplifies storage	water (N)
Mixer, stationary May 29 136	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer Stationary May 29 186	Simplifies storage	water (N)
Mixer Stationary May 29 186	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N) July 10 *76 Explosions Electrical safety in hazardous process areas—report. R. W. Scott (charts & tables) July 10 *123 Explosion suppression: new safety tool. C. B. Hammond Dec. 25 Explosives—PETN plant covered with tons of earth to mitigate hazards (N) Mar. 20 *96 Exports—Potash producers step up capacity to meet world demand (charts & tables) (N) Oct. 16 Extraction—Lean gas yields chemical feedstocks at Cow Island, La., plant —flowsheet. T. H. Arnold Jr July 24 *118 F Feeders Design a Venturi feeder for dry bulk materials, E. J. Gibbons (P.N.) July 10 *158 Spiral brush can feed or screen dry material. S. A. Jones (P.N.), May 15 *188 Vibrating screw pushes solids into vacuum reactor system. A. N. Johnson & others (P.N.) Oct. 2 *124 Fermentation—Winemaking at Roma Wine keeps age-old process current —flowsheet. C. R. Havighorst Feb. 6 *76 Fertilizers Ammoniated phosphates—three current developments (chart) (N) May 15 *68 Concentrated fertilizers boost consumption of primary plant nutrients (N) May 29 India aims at eightfold jump in
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	Say water (N)
Mixer, stationary	Simplifies storage	water (N)
Mixer, stationary	Simplifies storage	Explosions Electrical safety in hazardous process areas—report. R. W. Scott (charts & tables) Explosion suppression: new safety tool. C. B. Hammond Dec. 25 Explosion suppression: new safety tool. C. B. Hammond Dec. 25 Explosives—PETN plant covered with tons of earth to mitigate hazards (N) Mar. 20 Exports—Potash producers step up capacity to meet world demand (charts & tables) (N) Oct. 16 Extraction—Lean gas yields chemical feedstocks at Cow Island, La. plant —flowsheet. T. H. Arnold Jr July 10 F Feeders Design a Venturi feeder for dry bulk materials, E. J. Gibbons (P.N.) Spiral brush can feed or screen dry material. S. A. Jones (P.N.), May 15 Spiral brush can feed or screen dry material. S. A. Jones (P.N.), May 15 Vibrating screw pushes solids into vacuum reactor system. A. N. Johnson & others (P.N.) Oct. 2 Fermentation—Winemaking at Roma Wine keeps age-old process current —flowsheet. C. R. Havighorst. Feb. 6 Ferrocene offered in development quantities Aug. 21 Fertilizers Ammoniated phosphates—three current developments (chart) (N) May 15 Concentrated fertilizers boost consumption of primary plant nutrients (N) May 29 India aims at eightfold jump in nitrogenous fertilizers (N). Apr. 17 Inventory—semiannual inventory of new plants and facilities Apr. 17 Outlook—Forecast for '61 report of new plants and facilities Apr. 17 Phosphate fertilizer helps fireproof forests (N) Oct. 30 Potash producers step up apacity to
Mixer, stationary	Simplifies storage	Explosions Electrical safety in hazardous process areas—report. R. W. Scott (charts & tables)
Mixer, stationary	Simplifies storage	Explosions Electrical safety in hazardous process areas—report. R. W. Scott (charts & tables)
Mixer, stationary	Simplifies storage	Explosions Electrical safety in hazardous process areas—report. R. W. Scott (charts & tables)

10 *191
29 *134
22 * *199
1 *1 *133
20 *208
4 *185
4 *185
1 *187
1 *187
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188
1 *188

d 5 82 e 4 *118 t 6 *108

*123 85 *96 98 *118

*158 *188 *124 *76 82 *68

Superphosphoric acid paves way for	Pt 2-Fractionation at Geisman	Jet fuel additive prevents ice forma-	
fertilizer shift—flowsheet. M. M. Striplin, Jr	Aug. 7 *104 Magnesium producer shuns electrolysis	Motor fuel test may cut blending cost	62
Fibers	B. L. Barnes	(N)Feb. 6	*50
Ceramic spun into heat-resistant fiber Feb. 6 64	Mercury—Metalsalts Corp. process Dec. 11 *120	Oil finds new market in ironmaking (N)Oct. 30	55
Cotton-can cheaper acrylonitrile	Methane reforming: pressure goes up	Petroleum additives face a mixed	
charm cotton (table) (N)Sept. 4 62 Dust filter fabric selection depends on	in French plant	future (charts) (N)July 24 Solid rocket fuel advances require	72
clastrostation R R Frederick	methylamines expansion Aug. 21 *100	better fuels and oxidizers (N). Jan. 9	4.3
(charts & tables)June 26 *100 Fabric won't melt, sublimes at 6,600 F.	Naphthalene — First petrochemical naphthalene	C	
Oct. 16 *110	Nitrogen-Low-pressure process yields	G	
Inventory—semiannual inventory of new plants and facilitiesApr. 17 173	high-pressure nitrogenNov. 13 *180 "Oil" refinery, new style, geared to	Gas	
Inventory—semiannual inventory of	hydrocarbons trend Oct. 16 *160	Calculate pressure drop for flowing	
new processes and technology Jan. 23 128	Petrochemicals — First petrochemical step a big one. T. H. Arnold, Jr.	gases (tables). Frank Lipinski (P.N.) July 10	164
Nonwoven fabric, called Fiberloc,	Sept. 4 *106	(P.N.) July 10 Cryogenic or pressure storage for liquid gases? N. R. Hower (charts)	
made by new felting process. May 15 86 Nylon-fiber market boosted by seat	Pigments—How to make azo pigments Jan. 9 *74	nquid gases? N. R. Hower (charts) May 29	+77
belts (N)	Pulp plant wrings profit from lightn	Estimate water of saturation. Ramon	
Pluton, organic fiber, won't melt even at 18,000 FFeb. 6 *62	M. D. RobbinsJune 26 *100 Superphosphoric acid paves way for	Oliu (chart) (P.N.)Mar. 20 Humidification — apply fluidization	174
Progress in high-polymer science.	fertilizer shift. M. M. Striplin, Jr.	mehtods, Norman EpsteinDec. 25 Industrial gases—Forecast for '61	81
Mark & Atlas (tables)Dec. 11 143 Rayon tire cord perks up (chart) (N)	Sept. 18 *160 Urea—Fresh ideas improve urea proc-	report	* 50.53
July 10 *70	winery keeps age-old process current.	cryogenics? (table) (N)Feb. 20	94
Teflon yarn for braided packings Oct. 30 74	C. R. Havighorst	Methane reforming—French synthesis	
Weather-resistant finish for fabrics Oct. 30 72	Fluidization—Apply fluidization to gas humidification. Norman Epstein	flowsheet	*158
Filtration	Dec. 25 *81	flowsheet	
(hange filter bags quickly, R. W. Moore (P. N.)July 10 160	Fluids Empirical equation for non-New-		*154
Dust filter selection depends on elec-	tonian systems. N. H. Chen (P. N.)	Reformer—unique reformer debuts in U. S., supplies reducing gas to pilot	
& tables)June 26 *100	How to design fluid-flow distributors.	kiln (chart) (N)Oct. 30	*54
Emergency filter-cloth support made	D. R. Richardson	Scrub tower removes halogen off-gases. John Holmes (P.N.)Dec. 25	92
of wood. R. E. Leonard (P. N.) Mar. 20 *180	Non-Newtonian fluid-flow scaleup. R. L. Bowen, Jr. (charts & tables)	Ultrasonic precipitation for gas clean-	0.4
Filter aids-new guide to selection	Pt 1. Designing laminar-now systems	ing, air pollution control—Ultra- sonics report. R. M. G. Boucher	
and use. T. M. Jackson, Jr. (table) Mar. 20 *141	Pt 2. Determining end of laminar	(charts & tables)Oct. 2	*84
Glass-fiber air filter works at 500 F.	regionJune 26 127	Gasoline Additives face a mixed future (charts)	
Plastic grids in trickling filter ease	Pt 3. Turbulent flow—a historical reviewJuly 10 147	(N)July 24	72
pulping waste-disposal (N) Aug. 21 *70	Pt 4. Designing turbulent-flow sys- temsJuly 24 143	Hydrocracking processes—surge ahead (chart & tables)	*38
Teffon in felt form for filters. Oct. 16 110 Troubleshooting new equipment— plant startup. Pt. 2. J. E. Troyan	Pt 5. How to handle slurries. Aug. 7 129	Sinclair's fuel test may replace octane	*50
plant startup. Pt. 2. J. E. Troyan Mar. 20 149	Pt 6. Best methods for obtaining flow data	rating methods (N)Feb. 6 Gems—Flame-grown gemstones enjoy	
Fire Protection	Pt 7. Interpreting and converting	broadened use in optics and high- fashion (N)Dec. 25	26
Coating—intumescent paint foils fire Oct. 16 *112	Process control report—Analysis of	Generators	20
Disaster control demands a pre-	fluid-system dynamics, A. R. Peck	Acyclic unit generates direct current directly (N)Nov. 27	*58
planned program—reportAug. 7 *111 Electrical safety in hazardous process	(charts & tables)June 12 *193 Statistical mechanics — statistical	Hydrogen generator produces cheap	0.6
Electrical safety in hazardous process areas—report. R. W. Scott (charts	theory of fluid transport phenomena.	hydrogen by simple adsorption (charts) (N)	*72
& tables)July 10 *123 Explosion suppression: new safety tool.	J. S. DahlerJan. 9 *111 Transport phenomena. L. D. Smoot. see	(charts) (N)	
C. B. HammondDec. 25 85 Fire extinguisher, using fluorocarbon,	"CE Refresher"	ators—ceramics offer new hope for containing plasma (N)July 24	70
outstrips its theoryAug. 7 *78	Fluorocarbon fire extinguisher outstrips its theory	Sonic generators in aerosol precipita-	
Flammable vapors ejected from British plant by jet (N)Apr. 17 *132	Fluorosilicones: built-in solvent resist- ance (chart)Oct. 30 *70	tion—Ultrasonics report. R. M. G. Boucher (charts & tables)Oct. 2	*84
Model fires speed tests of powder ex-	Foams	Sun-powered generator can run irri-	*96
tinguishers (N)Apr. 3 106 Phosphate fertilizer helps fireproof for-	Du Pont froth process for foaming urethanes (N)Oct. 30 60	gation pumps (N)Oct. 16 Germanium—Vapor-phase process grows	
ests (N)Oct. 30 60	Foam separation technique set to go	germanium wafers (N)May 15 Germany	78
Flocculation—Zeta potential: new tool for water treatment. T. M. Riddick	commercial (N)	Bayer process gives Germany major	
(charts) Pt. 1June 26 *121, Pt. 2 July 10 *141	Foamthane, polyurethane foam, in-	domestic source of sodium borohy- dride. T. P. Forbath (chart) (N)	
Floors	sulates over a 500 F. spanApr. 3 *112 Mexico—polyurethane boom starts (N)	June 12	92
Cement—lightweight cement cuts floor topping installation costsFeb. 6	May 1 48	Chlorite plant casts Kesting process in its original sodium-chlorite role-	
Slippery surfaces acquire grip with	Nopco's Brobdingnagian loaf of poly- urethane foamJuly 24 *80	flowsheet. T. P. ForbathJune 12 News behind the news: T. P. Forbath	180
new epoxy adhesiveFeb. 6 *66 Urethane floor finish dries in humid air	Plastic foams face soaring construc-	in BerlinOct. 30	128
Flotation Sept. 4 78	tion market (N)	Germicide—anhydrous new germicide in	
Beryllium Resources to produce beryl-	Nov. 27 *70 Urethane foam sprayed under high-	liquid form also acts as deodorant Dec. 25	43
lium concentrates from Utah clay	way bridges delays icingApr. 17 144	Glass microballoons, bulk filler for plas- tics	*56
Monomolecular films succeeds as anti-	Urethane insulation won't shrink at low temperatures	Glass Fibers	
cakers, dust killersJuly 10 80 Flowsheet format—Tabulated "ledger"	Formaldehyde	Glass-fiber air filter works at 500 F. July 10	82
format aids clarity. Ross & Fresh-	Melamine-formeldehyde cures enamels quickly without catalystsApr. 17 144	Owens-Corning's new Aiken plant fea-	
WaterApr. 17 *177	Montecatini route savors success (N)	tures process modernity—flowsheet May 15 *	136
Alum-Inside view of a modern alum	Feb. 6 *44 Forming—Blow-molding process triples	Gold salts improve electroplating of	9.4
plant. E. K. SheldonMar. 20 *132 Attapulgite productsDec. 25 *60	output of polyethylene bottles (N)	transistors	0.4
Attapulgite products Dec. 25 *60 Beet sugar: a radical new look at Holly Sugar. C. R. Havighorst.Oct. 2 *76	Fractionating—Lean gas venture in	lasting in acid serviceNov. 13 * Great Britain	262
Butadiene—New catalyst for butadiene	Fractionating—Lean gas venture in Louisiana—payoff fractionation plant	Corn yields maze of products at Eng-	
unit-flowsheet. T. H. Arnold, Jr. Oct. 30 *90	—flowsheet. T. H. Arnold, JrAug. 7 *104 Fuels	lish plant—flowsheet. T. P. Forbath Mar. 6	*90
Carbon black boom spurred by new	Additive won't leave deposits in com-	Petrochemicals boom (table) (N)	50
entry-United Carbon France S. A.	bustion chambersJan. 9 60 AEC picks plants for spent-fuel re-	Mar. 6 Grinding—Closed-circuit grinding—how	58
plant	processing (N)July 24 76	to get maximum output. C. A. Lee	112
Chlorite plant casts Kesting process in its original role. T. P. Forbath	Atomic fuels industry re-examines its economics (N)June 12 93	Guatemala-Refinery built in jungle from	110
June 12 *180	Blending at Union Oil uses turbine	skid-mounted units made in U.S.A. (N)Jan. 9	*42
Citric acid—New contender enlivens citric acid pictureApr. 3 *122	meters, all-digital controls (N) May 29 *46	Gums-Synthetic gums push for two big	14
Corn—Process maze vields maize prod-	Coal's place in 1975 energy picture (chart & tables) (N)Nov. 27 54	markets (charts & tables) (N) Aug. 21	66
Glass fibers-New plant features latest	Energy needs keep fuels lively-Fore-		
look in making glass fibers. May 15 *136 Heavy-water plant melds new features	cast for '61 reportJan. 9 84 Fuel cell—new sodium-chlorine sys-	H	
Feb. 20 *118	tem boosts voltage (N)June 12 *104	Work	
Lean gas venture in Louisiana yields chemical feedstock, T. H. Arnold Jr.	Fuel cells—hydrogen still looks best for fuel cells (N)Jan. 9 50	Heat Numerical solution of the heat con-	
- Extraction at Cow Island	Industry's energy demand set to soar	Numerical solution of the heat conduction equation. Y. L. Luke (tables)Jan. 9	*95
July 24 *118	(charts) (N)July 24 78	(canton)	0.0

Silicon heating elements operate up		Inorganic Chemicals		Statistical mechanics—statistical the-
to 1700 C Apr. 3 Heat Exchangers	*111	Inorganic-polymer chemistry points way to high-temperature plastics.		ory of fluid transport phenomena. J. S. DahlerJan. 9 *111 Systems engineering. T. J. Williams
Continuous strip regenerative exchanger	*86	Inventory-semiannual inventory of	*117	Systems engineering. T. J. Williams See under Engineering.
uses flexible strips (N)Dec. 11 Estimating air-cooled exchangers made easy. Murtha & FriedmanFeb. 6	9	new plants and facilitiesApr. 17 Inventory—semiannual inventory of	168	_
Evaluate heat exchanger coefficients.		new processes and technology Jan. 23		L
J. F. Frantz (table)Mar. 20 Graphite heat exchangers are long-		Non-aqueous solvent systems. Katz &		Labor
lasting in acid service Nov. 13 Testing for leaks in heat exchangers.	*262	Outlook-Forecast for '61 report		CE Cost File 53. Construction labor units. R. T. Witherspoon, Jr. June 12 262
F. L. Rubin July 24 Titanium exchangers replacing glass	*160	Jan. 9 Insecticides—Sterilant can control house-		Professional men in the middle need a
for chlorine cooling (table)July 24	*170	fliesDec. 11 Instruments	90	sounding-board organization. R. R. Stokes
Troubleshooting new equipment— Plant startup. Pt. 2. J. E. Troyan	1	Automatic moisture analyzers monitor	70	Strike guidelines for engineers set by NSPE
Heat Transfer	149	variety of streams (N)June 26 Barometric fluctuations halted with	10	Lactic Acid—New lactic acid solutions improve foods and plasticsMar. 6 82
Film coefficients for glass-lined re- actors. G. M. Machwart (chart)		do-it-yourself device. Gerhard Hub- ner (P.N.)	*184	Law CPI may face stiffer pollution laws
(P.N.)Apr. 17	204	CE Cost File Process instrumenta- tion elements. B. G. Liptak		Jan. 23 *78
Flexible strips conduct heat in novel heat exchanger (N)Dec. 11	*86	tion elements. B. G. Liptak 55 Control and relief valves. Aug. 7 59 Process control instruments	137	Depreciation law gets industry support (N)
Saline water conversion gets two new heat-transfer techniques (N). Jan. 23		Nov. 27 60 Process-vessel protectors, Dec. 25	140	planned police assistance—report
Simultaneous heat and mass transfer-		Device for continuous CO2 indica-	*120	Aug. 7 *118
CE Refresher. Coates & Pressburg (charts). Pt 1 May 29-95, Pt 2 June		Diatometers indicate effectiveness of		Trade secrets—how courts have defined trade secrets. A. W. GrayJan. 9 *120 Lead—Linings—how to choose lead lin-
26-131, Pt 3 July 24 Transport phenomena. L. D. Smoot see under CE Refresher	151	stream pollution control (N)Aug. 7 Pneumatic or electronic instruments?	*66	ings for process vessels. R. L. Zieg-
see under CE Refresher		Process control report. Danatos &	*62	feld (charts & tables) Jan. 23 *164 Lignin—Pulp plant produces commercial
Use curves for heat transfer. V. S. Gupta (P.N.) Jan. 23 Use one-step equations to find reboiler	*158	Schall (charts & tables)June 12 Pt 1 PrinciplesJune 12	*187	dimethyl sulfoxide from lignin—flow- sheet. M. D. RobbinsJune 26 *100
and condenser duty. J. L. Beckner		Pt 2 ComponentsJune 12	213	Filter aids to use in "difficult" filtra-
Vibration and pulsation boost heat	-101	Rheometer—extrusion rheometer, best device for obtaining flow data. R. L. Bowen Ir. 21	****	tions. T. M. Jackson, Jr. (charts) Mar. 20 *141
table)	*171	Bowen, Jr	*119	Liquefied gases for cryogenics-busi-
Helium conservation program gets good industry response (N)May 1	36			ness prospects (table) (N). Feb. 20 94 Liquid neon makes ideal refrigerant
Hose—Teflon flexible hose solves fluid- handling problems. E. M. Ramberg		Turbidity meter made from fluorescent tube, B. F. Symons (P.N.) Sept. 4		Jan. 9 60 Metals—flanged joints for liquid-metal
(tables)Feb. 20	*180	Asbestos insulation impregnated with		service, Clifford & Burnet Sept. 18 *179 Nomograph gives diffusion rate in di-
Gas humidification—apply fluidization methods Norman Epstein. Dec. 25	*81	polyester	70	lute solutions, J. F. Kuong (P. N.) June 12 *258
methods. Norman EpsteinDec. 25 Nomograph gives density of moist or dry air F. Caplan (P.N.) Oct. 30	126	Foamthane, polyurethane foam, in-	64	Phthalic anhydride—molten phthalic anhydride speeds processing (chart)
Nomograph gives density of moist or dry air. F. Caplan (P.N.)Oct. 30 Simultaneous transfer of heat and mass CE Refresher. Coates &	136	Foamthane, polyurethane foam, in- sulates over a 500 F. spanApr. 3 Foam-up "paints" for high-tempera-	*112	(N)
		Foam-up "paints" for high-tempera- ture coatingsJune 26 Linde's "Super Insulation" permits	78	Contribucal numb Inherication I H
Pt 2 June 26-131, Pt 3 July 24 Hydraulic presses—CE Cost File 51.	151	tankcar haulage of cryogenic ma-		Doblin (table) Oct. 16 *210 Combination of molybdenum disulfide
Hydrazine binds oxygen to reduce corro-	194	Pipe fittings can get "Metal-On" cover	*66	Dec. 25 44
sion	262	with "Miter Seal" bandsNov. 13 Polyethylene bids for intercontinental	*258	Dry-film lubricant unaffected by liquid
Hydrocarbons Biocide may eliminate bacteria in	7.4	cables	82	Fluorosilicones—lubricants with built- in solvent resistance (chart). Oct. 30 *70
hydrocarbons (N)Oct. 2	54	SHICEOUS HOUS GHU MANIMUM COLORS		
Canadian Oil refinery geared to hydro-		upOct. 2	58	Lubes anticipate space demands (N) Mar. 6 *59
Canadian Oil refinery geared to hydro- carbons trend—flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more	*160	Stainless steel jacket protects pipeline insulation		Mar. 6 *59
Canadian Oil refinery geared to hydro- carbons trend—flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields		up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high- way bridges delays icing. Apr. 17		Lubes anticipate space demands (N) Mar. 6 *59
Canadian Oil refinery geared to hydro- carbons trend-flowsheet,Oct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr.	*160 82	up Oct. 2 Stainless steel jacket protects pipeline insulation	*146	Mar. 6 *59 M Magnesium
Canadian Oil refinery geared to hydro- carbons trend-flowsheet,Oct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24	*160 82 *188	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high- way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as inter- mediates—capacity, outlook (chart)	*146 144 86	Mar. 6 *59 M Magnesium Magnesium in galvanizing zinc improve corrosion resistanceOct. 16 *226
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and	*160 82 *188 *104	up Oct. 2 Stainless steel jacket protects pipeline insulation and sprayed under highway bridges delays (cing Apr. 17 Urethane insulation won't shrink at Intermediates—toeymates gain an artemediates—capacity, outlook (chart) Intermediates—capacity, outlook Sept. 18 Ion Exchange	*146 144	Mar. 6 *59 M Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 *226 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet.
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Add—Hydrochloric and nitric acids: a current look (charts & table) (N)Mar. 6	*160 82 *188 *104	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Ion Exchange Abiperm and Ontario Research re-	*146 144 86	Mar. 6 *59 M Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 *226 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)Mar. 6 Hydrocyanic Acid Noncatalytic reaction, developed by	*160 82 *188 *104	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) Sept. 18 On Exchange Abiperm and Ontario Research recovery processes ease pulping problems (chart) Aug. 7 Ion-exchange resins and membranes.	*146 144 86	Mar. 6 *59 M Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 *226 Pidgeon process at Alabama Metallungical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louislana yields chemical feedstocks—two flowsheets. T. H. Arnold. Jr. T. H. Arnold	*160 82 *188 *104 66	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Ion Exchange Abiperm and Ontario Research recovery processes ease pulping problems (chart) Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables)	*146 144 86 74	Mar. 6 *59 M Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 *226 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louislana yields chemical feedstocks—two flowsheets. T. H. Arnold. Jr. T. H. Arnold	*160 82 *188 *104 66	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Ion Exchange Abiperm and Ontario Research recovery processes ease pulping problems (chart) Aug. 7 Ion-exchange resins and membranes, H. P. Gregor (charts & tables) Dec. 25 Iron—ACAR, direct iron-reduction proc-	*146 144 86 74	Mar. 6 *59 M Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 *226 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)Mar. 6 Hydrocyanic Acid Noncatalytic reaction, developed by Shawinigan, boosts yield (chart) (N)Sept. 18 Safety network guards HCN over vast transit route (N)Sept. 18 Hydrocealkylation	*160 82 *188 *104 66	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Ion Exchange Abiperm and Ontario Research recovery processes ease pulping problems (chart) Aug. 7 Ion-exchange resins and membranes, L. P. Gregor (charts & tables) Dec. 25 Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N)	*146 144 86 74	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louislana yields chemical feedstocks—two flowsheets. T. H. Arnold. Jr. T. H. Arnold. Jr. T. H. Arnold. Jr. T. Hydrochloric and GeismarAug. 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)Mar. 6 Hydrocyanic Acid Noncatalytic reaction, developed by Shawhingan, boosts yield (chart) (N)Sept. 18 Safety network guards HCN over vasat transit route (N)Sept. 18 Hydrocealkylation HDA, thermal hydrodealkylation route to petrochemical benzene and naph-	*160 82 *188 *104 66 72 *68	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Ion Exchange Abiperm and Ontario Research recovery processes ease pulping problems (chart) Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) May 15 Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sent. 18	*146 144 86 74 70 *73	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louislana yields chemical feedstocks—two flowsheets. T. H. Arnold. Jr. Extraction at Cow IslandJuly 24 Factorie at Cow IslandJuly 24 Factorie Acid—Hydrochlorie nitric acids: a current look (chard nitric acids: a current look (chard k table) (N)Mar. 6 Hydrocyanic Acid Noncatalytic reaction, developed by Shawinigan, boosts yield (charl) Safety network guards HCN over vast transit route (N)Sept. 18 Hydrocyanel hydrodealkylation route Hydrocalkylation Hydrocalkylation Lopetrochemical benzene and naph- thalene (charl) (N)Apr. 17 HDA. process—Argentina will builden	*160 82 *188 *104 66 72 *68	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Ion Exchange Abiperm and Ontario Research recovery processes ease pulping problems (chart) Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) May 15 Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sent. 18	*146 144 86 74 70 *73	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metaliurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) In Exchange Sept. 18 In Exchange resins and membranes Sept. 18 In Exchange resins and membranes Sept. 18 In Exchange S	*146 144 86 74 70 *73 78 74	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 *226 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at Geismar Aug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N) Mar. 6 Hydrocyanic Acid Noncatalytic reaction, developed by Shawinigan, boosts yield (chart) (N) Sept. 18 Safety network guards HCN over vast transit route (N) Sept. 18 Hydrodealkylation HDA, thermal hydrodealkylation route to petrochemical benzene and naph- thalene (chart) (N) Apr. 17 HDA process—Argentina will build first HDA benzene plant (N) May 15 Hydeal process launches petrochemical annith balone at Ashtand (II) & Re-	*160 82 *188 *104 66 72 *68	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) ION Exchange Sept. 18 ION Exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Iron—ACAR, direct iron-reduction process, uses kin-within-kiln (N) May 15 Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 29	*146 144 86 74 70 *73	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 *226 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at Geismar Aug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N) Mar. 6 Hydrocyanic Acid Noncatalytic reaction, developed by Shawinigan, boosts yield (chart) (N) Sept. 18 Safety network guards HCN over vast transit route (N) Sept. 18 Hydrodealkylation HDA, thermal hydrodealkylation route to petrochemical benzene and naph- thalene (chart) (N) Apr. 17 HDA process—Argentina will build first HDA benzene plant (N) May 15 Hydeal process launches petrochemical annith balone at Ashtand (II) & Re-	*160 82 *188 *104 66 72 *68	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) Sept. 18 Intermediates—socyanates gain as intermediates—capacity Sept. 18 Intermediates—capacity Sept. 18 Intermediates—capacity Aug. 7 Isocyanates gain as intermediates—capacity Aug. 7 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 25	*146 144 86 74 70 *73 78 74	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 *226 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Ion Exchange Sept. 18 Ion Exchange Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) 18 Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isoprene—French route seen boosting polylsoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 29 Janan	*146 144 86 74 70 *73 78 74	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 *226 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at Geismar Aug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N) Mar. 6 Hydrocyanic Acid Noncatalytic reaction, developed by Shawinigan, boosts yield (chart) (N) Sept. 18 Safety network guards HCN over vast transit route (N) Sept. 18 Hydrodealkylation HDA, thermal hydrodealkylation route to petrochemical benzene and naph- thalene (chart (N) Apr. 17 HDA process—Argentina will build first HDA benzene plant (N) May 15 Hydeal process launches petrochemical applithalene at Ashland Oil & Re- fining—flowsheet Hydeal process kins Kirkpatrick Award honors for Ashland Oil (N) Oct. 2 *46, Nov. 13-189, Chean bydrogen via adsorption	*160 82 *188 *104 66 72 *68 128 72 *70 *197	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Ion Exchange Sept. 18 Ion Exchange Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) 18 Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isoprene—French route seen boosting polylsoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 29 Janan	*146 144 86 74 70 *73 78 74	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—isocyanates gain as intermates—capacity, outlook (chart) Sept. 18 Abiperm and Ontario Research recovery processes ease pulping problems (chart) Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 25 Japane Atomic energy development gets 29-year plan (N) Mar. 29 Japanese chemicals boom. D. F.	*146 144 86 74 70 *73 78 74	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—isocyanates gain as intermates—capacity, outlook (chart) Sept. 18 Abiperm and Ontario Research recovery processes ease pulping problems (chart) Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 25 Japane Atomic energy development gets 29-year plan (N) Mar. 29 Japanese chemicals boom. D. F.	*146 144 86 74 70 *73 78 74 *42	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydro- carbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Ion Exchange Sept. 18 Ion Exchange Sept. 18 Ion exchange resins and membranes Aug. 7 Ion-exchange resins and membranes H. P. Gregor (charts & tables) Aug. 7 Ion-exchange resins and membranes H. P. Gregor (charts & tables) Sept. 18 Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 29 Japan Atomic energy development gets 29-year plan (N) Mar. 29 Japanese chemicals boom. D. F. Othmer (chart) Feb. 6 Ofmer (chart) Feb. 6 Organics on the move in Japan of tables (N) Mar. 29 Organics on the move in Japan of tables (N) Mar. 20	*146 144 86 74 70 *73 78 74 *42	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Ion Exchange Sept. 18 Ion Exchange Sept. 18 Ion exchange resins and membranes Aug. 7 Ion-exchange resins and membranes H. P. Gregor (charts & tables) Aug. 7 Ion-exchange resins and membranes H. P. Gregor (charts & tables) Sept. 18 Isocyanates gain as intermediates—capacity, outlook (chart) (N) Sept. 18 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 29 Japan Atomic energy development gets 29-year plan (N) Mar. 29 Japanese chemicals boom. D. F. Othmer (chart) Feb. 6 Ofmer (chart) Feb. 6 Organics on the move in Japan of tables (N) Mar. 29 Organics on the move in Japan of tables (N) Mar. 20	*146 144 86 74 70 *73 78 74 *42	Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) Intermediates—secyanates gain as intermediates—capacity, outlook (chart) Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 29 Japan Atomic energy development gets 20-year plan (N) Mar. 20 Japanese chemicals boom D. F. Othmer (chart) Mar. 20 Japanese chemicals boom D. Fe. Othmer (chart) Feb. 6 Organics on the move in Japan (tables) (N) Mar. 20 Joining—Copper-joining by diffusion-bonding method Mar. 6 Joints—Flanged joints in liquid-metal service. Clifford & Burnet. Sept. 18	*146 144 86 74 70 *73 78 74 *42	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72 62 50	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) Ion Exchange Sept. 18 Ion Exchange Sept. 18 Abiperm and Ontario Research recovery processes ease pulping problems (chart) Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 25 Japana Atomic energy development gets 20-year plan (N) Mar. 20 Japanese chemicals boom D. F. Othmer (chart) Mar. 20 Japanese chemicals boom D. Feb. 6 Organics on the move in Japan (tables) (N) Mar. 20 Joining—Copper-joining by diffusion-bonding method Mar. 6 Joints—Flanged joints in liquid-metal service. Clifford & Burnet . Sept. 18	*146 144 86 74 70 *73 78 74 *42	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72 62 50 *66 82	up. Oct. 2 Stainless steel jacket protects pipeline insulation	*146 144 86 74 *73 78 74 *42 96 *54 94 *148	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowshed in the process of th
Canadian Oil refinery geared to hydrocarbons trend—flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochioric Acid—Hydrochioric and nitric acids: a current look (charts & table) (N)Mar. 6 Hydrocyanic Acid Noncatalytic reaction, developed by Shawinigan, boosts yield (chart) (N)Sept. 18 Safety network guards HCN over vast transit route (N)Sept. 18 Hydrodealkylation HDA, thermal hydrodealkylation route to petrochemical benzene and naphthalene (chart) (N)Apr. 17 HDA process—Argentina will build first HDA benzene plant (N).May 15 Hydeal process launches petrochemical apphthalene at Ashland Oil (R) Hydrogen Oct. 2*46, Nov. 13-188, Hydrogen Cheap hydrogen via adsorption (charts) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72 62 50 *66 82 42	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane (oam sprayed under highway bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intendiates—seogyanates gain as intermediates—capacity, outlook (chart) (N) Ion Exchange Sept. 18 Abiperm and Ontario Research recovery processes ease pulping problems (chart) Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isopholysoprends show of synthete rubber market. Helen Avati chart & table) (N) May 29 Japan Atomic energy development gets 29-year plan (N) May 29 Japanese chemicals boom. D. F. Othme (chart) P. F. Goranics on the move in Japan (tables) (N) Mar. 20 Joining—Copper-joining by diffusion-bonding method Mar. 6 Joints—Flanged joints in liquid-metal service. Clifford & Burnet. Sept. 18 K Kilns—Kiln-within-kiln reduces iron concentrates directly (N) May 15 Kinetics	*146 144 86 74 70 *73 78 74 *42 96 *54 94 *148	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowshed in the process of th
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72 62 50 *66 82 42	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane (oam sprayed under highway bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures	*146 1144 86 74 70 *73 78 74 *42 96 *54 94 *148 *179	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72 62 50 *66 82 42	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) Ion Exchange Sept. 18 Ion Exchange resins and membranes. Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isopren—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 29 Japan Atomic energy development gets 29-year plan (N) May 29 Japanese chemicals boom D. F. Othmer (chart) Mar. 29 Japanese chemicals boom D. F. Othmer (chart) Peb. 6 Organics on the move in Japan (tables) (N) Mar. 29 Joining—Copper-joining by diffusion-bonding method Mar. 6 Joints—Flanged joints in liquid-metal service. Clifford & Burnet. Sept. 18 K Kilns—Kiln-within-kiln reduces iron concentrates directly (N) May 15 Kichenical kinetics—expanding field. Martin Kilpatrick Oct. 39 Decsigning temperature-stable reactors.	*146 1144 86 74 70 *73 78 74 *42 96 *54 94 *148 *179	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrocarbonation at GeismarAug. 7 Hydrocyanic Acid Noncatalytic reaction, developed by Shawinigan, boosts yield (charts) (N)Sept. 18 Safety metwork guards HCN over vask transit route (N)Sept. 18 Hydrodealkylation HDA, thermal hydrodealkylation route to petrochemical benzene and naph-flower (charts) Hydrodealkylation HDA, thermal hydrodealkylation route to petrochemical benzene and naph-flower (charts) Hydrodealkylation HDA, thermal hydrodealkylation route to petrochemical benzene and naph-flower (charts) Hydrogen et Ashland Oil & Refining—flowsheet	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72 62 50 *66 82 42	up. Oct. 2 Stainless steel jacket protects pipeline insulation	*146 1144 86 74 70 *73 78 74 *42 96 *54 94 *148 *179 78	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metaliurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72 62 50 *66 82 42	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane (coam sprayed under highway bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—isocyanates gain as intermediates—seocyanates gain as intermediates—capacity, outlook (chart) Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 25 Japana Atomic energy development gets 29-year plan (N) Max. 29 Japanese chemicals boom. D. F. Othmer (chart) Max. 29 Japanese chemicals boom. D. F. Othmer (chart) Max. 20 Joining—Copper-Joining by diffusion-bonding method Mar. 6 K Kilns—Kiln-within-kiln reduces iron concentrates directly (N) May 15 Kneties Chemical kinetics—expanding field. Martin kilpatrick	*146 1144 86 74 70 *73 78 74 *42 96 *54 94 *148 *179 78 *111 165 81	Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 *226 Pidigeon process at Alabama Metaliurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend-flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochloric Acid—Hydrochloric and nitric acids: a current look (charts & table) (N)	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72 62 50 *66 82 42	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane foam sprayed under high-way bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—Isocyanates gain as intermediates—capacity, outlook (chart) No Sept. 18 Ion Exchange Sept. 18 Ion Exchange Sept. 18 Ion exchange Sept. 18 Ion exchange resins and membra. 7 Ion-exchange resins and membra. 7 Ion-exchange resins and membra. 8 H. P. Gregor (charts & tables) Dec. 25 Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 29 Japan Atomic energy development gets 29-year plan (N) May 29 Japanese chemicals boom D. F. Othmer (chart) Feb. 6 Organics on the move in Japan (tables) (N) Mar. 29 Japanese chemicals boom bonding method Mar. 6 Joints—Flanged joints in liquid-metal service. Clifford & Burnet. Sept. 18 K Kilns—Kiln-within-kiln reduces iron concentrates directly (N) May 15 Pt. Packed-bed and stirred tank reactors. Peter Harriott (charts & tables) 19 Pt. 1 Tubular reactors May 15 Pt. 2 Packed-bed and stirred tank reactors May 29 Kinetic plots aid catalytic operations.	*146 1144 86 74 70 *73 78 74 *42 96 *54 94 *148 *179 78 *111 165 81	Magnesium Magnesium in galvanizing zinc improves corrosion resistance Oct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes
Canadian Oil refinery geared to hydrocarbons trend—flowsheetOct. 16 Cyclic C-8 hydrocarbons—two more synthesized from butadieneJuly 10 Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets. T. H. Arnold, Jr. Extraction at Cww IslandJuly 24 Fractionation at GeismarAug. 7 Hydrochoric and mitric acids—flydrochoric land nitric acids—a current look chand nitric acids.a current look chand Nan. 6 Hydrocyanic Acid Noncatalytic reaction, developed by Shawinigan, boosts yield (chart) (by Shawinigan, boosts yield (chart) (chart)Sept. 18 Setty network guards HCN over vest transit route (N)Sept. 18 Hydrodealkylation HDA, thermal hydrodealkylation route to petrochemical benzene and naph- first HDA benzene plant (N). May 15 Hydeal process—Argentina will first HDA benzene plant (N). May 15 Hydeal process launches petrochemical naphthalene at Ashland Oil & Re- fining—flowsheetMay Hydrogen Cheap hydrogen via adsorption (charts) (N)Mar. 6 Consumption surging; principle pro- duction is by steam reforming (charts) (N)Mar. 6 Sodium borohydride pellets seed as hydrogen sourceSept. 4 Hydrogen Peroxide—Bleaching agent for high-density pulp (N)Oct. 16	*160 82 *188 *104 66 72 *68 128 72 *70 *197 *72 50 *66 82 42 106	up Oct. 2 Stainless steel jacket protects pipeline insulation Aug. 21 Urethane (coam sprayed under highway bridges delays icing Apr. 17 Urethane insulation won't shrink at low temperatures May 15 Intermediates—isocyanates gain as intermediates—seocyanates gain as intermediates—capacity, outlook (chart) Aug. 7 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Iron—ACAR, direct iron-reduction process, uses kiln-within-kiln (N) Isocyanates gain as intermediates—capacity, outlook (chart) (N). Sept. 18 Isoprene—French route seen boosting polyisoprene's share of synthetic rubber market. Helen Avati (chart & table) (N) May 25 Japana Atomic energy development gets 29-year plan (N) Max. 29 Japanese chemicals boom. D. F. Othmer (chart) Max. 29 Japanese chemicals boom. D. F. Othmer (chart) Max. 20 Joining—Copper-Joining by diffusion-bonding method Mar. 6 K Kilns—Kiln-within-kiln reduces iron concentrates directly (N) May 15 Kneties Chemical kinetics—expanding field. Martin kilpatrick	*146 144 86 74 70 *73 78 74 *42 96 *54 94 *148 *179 78 *111 165 81 *115	Magnesium Magnesium in galvanizing zinc improves corrosion resistanceOct. 16 Pidgeon process at Alabama Metallurgical rivals electrolysis—flowsheet. B. E. Barnes

Ma

hena. . 9 •111

bor 12 262 1 a R. 6 *112 by 11 162 ons 6 82

ws 23 *78 ort . 6 62 les

7 *118
ed
9 *120
n923 *164
ial
w26 *100

as) 20 *141 si-20 94 nt 9 60 al 18 *179 i-.) 12 *258 ic t) 6 64

H. 16 *210 le n 15 44 de 4 86 t- 10 *70) 6 *59

6 •226

64 8 *198 *106 *170 112 *120 164 116 *160 *151 *138 144 256 •134 114 *206 *254 *104 *76 196

•216

Conference to evaluate methods for	r	Rubber-specialty rubbers for special uses (charts)		Molding Blow-molding process at Continental	
petro plant management coming (N) Dec. 1	82	Pt I Design data on specific elasto-	4004	Can triples output of polyethylene	
Contract maintenance—how far to go Apr.	3 •170	mers for gaskets and seals. Sept. 18 Pt II Chemical resistances of various		bottles (N)	84
Control maintenance by work measure- ment. H. J. Chandler (table). Feb. 6	•120	specialty rubbersOct. 2 Steel—new T-1 type equals old, costs		Progress in high-polymer science. Mark & Atlas (tables) Dec. 11	143
Disaster control — management must have a pre-planned program—report	t	Steels for rocket fuel applications, John	148	Sculpture reproduced with polysulfide rubber molds	*104
Aug. 7	*1111	Halbig Dec. 25 Ti-clad steel plate via Lukens' new process. R. V. Hughson May 15	108	rubber molds	60
How to appraise capital investments —report. J. W. Hackney (charts & tables)	145		*194	Moleculus Siaves	
How to improve the meetings you run. Surles & Stanbury		Mathematics Analog solves partial differentials.		Linde Co. wins CE's Kirkpatrick Award for molecular sieves (N) Oct. 2 *46, Nov. 13	#100
Is your eye on the executive suite? W. A. HertanSept. 4	•	Zabel & McKibbins	*121	Lande Co. 8 award-winning achieve-	103
Make management training count R		Multiplication result proved by simple	•103	Kirkpatrick (chart)Nov. 13	*192
P. Bott June 26 Operating "know-how" gets nowhere without "can-do". W. H. Richardson	-140	method. G. J. CarasFeb. 20 The new mathematics—see under	172	"Loaded" molecular sieves are key to one-component epoxiesNov. 27	*68
Jan. 9	124	Engineering—Conference on the New Chemical Engineering		Molybdenum disulfide—Lubricant com- bines MoS ₂ and TeflonDec. 25	4.4
Operating manuals—guide to prepara- tion and contents. J. E. Troyan		Numerical analysis—numerical solution of the heat conduction equation. Y.		Molybdenum-silver composite for high- temperature sealsApr. 17	142
Operations research: a progress report	-134	L. Luke (tables)Jan. 9 Numerical mathematics for chemical	•95	Mortar—epoxy mortar makes quakeproof wall	*80
J. C. Hetrick (table) Jan. 23 The Profitability Index (P. I.) in investment evaluation, W. D. McEach-	137	engineers. D. L. Whitley (charts &		Motors—CE Cost File 58: A.C. electric motors. William ShulmanOct. 30	140
ron (charts & tables)June 12	239	Quick statistical techniques-tests and	-101	motors. William ShulmanOct. 30 Mufflers—catalytic mufflers for auto fumes (N)	*88
Recruiting roundelayApr. 17 25 ways to better your recruiting skill	186	estimates. B. S. Brown (tables) Sept. 4	*137		
Sept. 18 Will you be able to run a 1985 firm?	•192	Statistical mechanics—statistical the- ory of fluid transport phenomena J.		N	
June 12 Manufacturing: art or science? W. H. Richardson	•249	S. DahlerJan. 9 Measurements	*111	Vanhthalana	
Richardson	*124	Automatic moisture analyzers monitor a variety of streams (N)June 26	70	Naphthalene Coke-oven producers move to counter	
comparative equipment costs, 1913 to		Increasing accuracy of planimeter measurements. S. N. Srivastava		oil's competition (N)June 26 HDA, thermal hydrodealkylation route	72
1960 (charts & table)Mar. 6 Marshall and Stevens indexes of com-		(P.N.)	98	to petrochemical naphthalene (chart) (N)Apr. 17	128
parative equipment costsJan. 9- 159, Jan. 23-182, Feb. 6-160, Feb. 20-213, Mar. 6-175, Mar. 20-212, Apr. 3-200, Apr. 17-236, May 1-134, May 15-220, May 29-142, June 12-303, June 26-179		plant measurements. W. H. Howe &	****	Hydeal hydrodealkylation process at Ashland Oil produces first petro-	
Mar. 6-175, Mar. 20-212, Apr. 3-200, Apr. 17-236, May 1-134, May 15-220,		others (charts)June 12 Melamine formaldehyde cures enamels		chemical naphthalene — flowsheet May 1	•70
		fast without catalystsApr. 17	144	Hydeal hydrodealkylation process wins Kirkpatrick Award honors for Ash-	
July 10-193, July 24-193, Aug. 7-178, Aug. 21-177, Sept. 4-196, Sept. 18-255, Oct. 2-163, Oct. 16-260, Oct. 30-158, Nov. 13-287; Nov. 27-157, Dec. 11-230 Dec. 25		Diphenyl mercury commercially avail-	80	land Oil	*197
Nov. 13-287; Nov. 27-157, Dec. 11-230	123	able		lene as phthalic feeds k (N) May 29	48
Misers	140	Metals	120	Petrochemical naphthalene may stabi-	10
Bell Telephone uses optical masers to convey phone conversations (N)	***	Diffusion coatings modify metal surfaces	116	lize erratic supply (chart) (N). G. E. Nicklaus. Jan. 23	82
Verneuil furnace makes ruby maser	•70	Electrolytic machining speeds metal shaping at Sifco (N)Mar. 20	•90	Petronaphthalene capacity: still surging (N)Oct. 2 Natural Gas	44
that amplifies light (N)Dec. 25	26	Inventory — semiannual inventory of new plants and facilitiesApr. 17	169	Canadian Oil refinery uses byproduct	
Mass Transfer see CE Refresher Materials Handling		Inventory — semiannual inventory of new processes and technology. Jan. 23	124	condensate from natural gas for feedstock—flowsheetOct. 16	*160
Ammonia—swing to storing NH ₈ cold in low-pressure tanks saves \$\$ (N)		Liquid metals—flanged joints in liquid- metal service. Clifford & Burnet	1	Copper refining—gas reduction opens new route (chart) (N)June 12 Fluor's solvent rids natural gas of	100
Feb. 20 Liquefied gases: cryogenic or pressure	•88	Sept. 18	•179	Fluor's solvent rids natural gas of excess CO ₂ (N)	50
storage? N. R. Hower (charts) May 29	•77	Metal-complex formation new data. A. E. Martell (charts & tables) Nov. 27	*95	Hydrogen production via steam re- forming of natural gas (charts) (N)	
Phthalic anhydride-molten anhydride		Nucerite, ceramic-coated metals, available in limited productionAug. 21	•150	Aug. 7 Industry's demand set to soar (charts)	62
speeds processing (chart) (N). Mar. 6 Safe siphoning of hazardous liquids. M. Siegel (P.N.)	•200	(N) Feb. 20	82	(N) July 24 Inventory—semiannual inventory of	78
Tags and magnet date stored material.		Plastics—acetal resins challenge light metals market	*110	new plants and facilitiesApr. 17 Inventory—semiannual inventory of	172
C. F. Bean (P.N.)	114	metals marketApr. 3 Plastics aim at metals' markets (chart & table) (N)May 1	44	new processes and technology Jan. 23	125
handling problems. E. M. Ramberg (tables)Feb. 20	*180	Plastics replace metals for corrosion- resistant scrubber	116	Lean gas venture in Louisiana yields chemical feedstocks—two flowsheets.	160
Ziegler catalyst components contamina- tion eliminated. Ford & Kiss (P.N.)		Platinum consumption up; outlook goodFeb. 6	134	T. H. Arnold, Jr.	****
Materials of Construction Aug. 7	-148	Rare metals pace quickens—Forecast	92	Extraction at Cow IslandJuly 24 Fractionation at GeismarAug. 7 Neon-Liquid neon makes ideal re-	•104
Acetal resins, Delrin and Celcon, chal- lenge light metals markets. Apr. 3	•110	for '61 report		frigerantJan. 9	60
Burlap, coated with polyethlene, for		vention (table)	•46	Nitrie Acid Hydrochloric and nitric acids: a cur-	
ments	•160	control refinery blending (N) May 29 Methacrylates available for copolymeriza-		rent look (charts & table) (N) Mar. 6	66
May 29		Methane	8.4	Nitric acid tail gas yields pure nitro- gen via catalytic purification	
Ceramics offer hope for containing plasma in MHD units (N)July 24 CE Cost File 52. Process-piping ma-	70	Conch International tells how liquid methane tanker performed (N)		(charts) (N)	102
CE Cost File 52. Process-piping ma-	190	Sept. 4	*64	Linde's Polarstream system uses liquid nitrogen as a refrigerant for trucks	
terials. Otto Mendel (tables) May 15 Chem Show unveils latest in materials	38	Frozen-earth process for storage of liquified methane (N)Nov. 27 Methane reforming; pressure goes up	*60	and railcars (N)	52
and equipment (N)Dec. 25 Copper-nickel alloy makes cheaper	38	in French plant-flowsheet. Apr. 17	•158	pressure British process—flowsheet Nov. 13	1100
tubes for feedwater heaters (tables) May 1	*114	Methanol extraction—key to improved wood-pulping? (N) Dec. 11 Methylamines' bullish outlook sires ex-	86	Purification process wrings pure nitro-	100
Metal-plastic compound cuts costs of die making	84	pansion—flowsheet Aug. 21	•100	gen from nitric fumes (charts) (N) Oct. 16	102
New materials: better plant repairs Mar. 6	144	Methylene chloride—Competition sharpens in chlorinated solvents (chart &		Nitrogen fluoridesDec. 11 Noise Control—Sound suppression in	92
Nucerite available in limited produc- tion Aug. 21	•150	table) (N)Oct. 30 Mexico—Polyurethane boom starts (N)	62	chemical process industries. R. L. Jacks (charts & tables)Feb. 20	*127
tion	•72	Milling May 1	48	Adipic acid process may alter nylon	
Penton-Hercules Powder's chlorinated	•112	Cast-stainless corn mill regists corro-	*960	picture (N) (chart)Apr. 17 Caprolactum — toluene-based route	130
Plastic-clad steel plate-Lukens inno-		sion	*90	challenges cyclohexane for economy (N)	*92
vation	44	shaping at Sifco (N)Mar. 20	*90	Casting process permits fabrication of large parts (N)	•72
Plastics differ widely in corrosion-	14	Minerals used by western CPI get U. S. survey (N)June 26	6.4	Dyeing aid Dec. 25 Epoxy adhesive allows bonding of	42
resistance, tests show (chart). Apr. 3 Further test results (chart). June 12	182 272	Resources draw increased attention (N)	36	nylon to nylon	90
Plastics for residential structures pro-		Russia gains in mineral strength (N) Feb. 6	48	Nylon gains in tire-cord fray-fore- cast for '61 reportJan. 9	*86
Polypropylene's tensile strength in-	•134	Mixing	4.5	Oriented nylon doubles life of con- veyor beltsJan. 9	*58
		Magnetic stirrer won't leak, has no seal (N)Feb. 20 Trailer-mounted mixer blends rocket	92	Seat belts boost nylon-fiber market (N)Aug. 7	74
Reinforced plastics for corrosive service. H. M. Webster (charts) Pt 1 June 26 *154, Pt 2July 10	*168	Trailer-mounted mixer blends rocket fuel on site (chart) (N)June 26	•66	Tire cord race—rayon perks up (chart) (N)July 10	*70

0		Petrochemical changes abound-Fore-	Change filter bags quickly. R. W.
Organic Chemicals		cast for '61 reportJan. 9 84 Petrochemicals: what's ahead—report. R. A. Labine (charts & tables)	Moore
Inventory—semiannual inventory of new plants and facilitiesApr. 17		Petroleum Sept.4 *113	Charts give vessel weight. Jackson
Inventory—semiannual inventory of new processes and technology	ť	Additives face mixed future (charts) (N)July 24 72	Cling
Jan. 23 Japanese heavy organics on the move (N) (tables)	9	Canada's oil and chemicals aim for better trade balance (N)May 29 50 Catalysis. Vladimir Haensel. Nov. 27 *105	well specifications. Mohammad Bashar
The organic semiconductor challenge. H. A. Pohl (chart & tables)Oct. 36		Conference to evaluate methods for petro plant management see under	Cleaning exhaust line may solve vac- uum problem. K. H. Parekh June 12 260
Organometallic—ferrocene offered in de- velopment quantitiesAug. 21		Management Fuel oil finds new market in iron-	Cut-out slide rule solves Stoke's law calculations. A. K. Postma. Nov. 27 *136 Design charts E. J. Gibbons. Aug. 7-154, Sept. 4-156, Oct. 2-126, Oct.
Oxidation Adipic acid produced by multistage air oxidation of cyclohexane (chart)		making (N) Oct. 30 55 Hydrocracking processes meet refiners' changing needs (chart & tables) (N)	7-154, Sept. 4-156, Oct. 2-126, Oct. 30-138, Nov. 27-134, Dec. 25 98
(N)	130	Inventory—semiannual inventory of	Design pump air chambers to control pressure pulsation, Carl Jahreis
Chlorine oxidation—French process solves waste HCl problems (chart)		new plants and facilitiesApr. 17 172 Inventory—semiannual inventory of new processes and technology	Sept. 4 *150 Design a Venturi feeder for dry bulk materials. E. J. GibbonsJuly 10 *158
(N)	42	Jan. 23 125 Outlook—CPI capsule forecasts for '61	Device takes samples during lab re- action. R. J. Johnson Feb. 20 *172 Do-it-yourself device stops barometric
direct, low-cost route to acetalde-	66	(N) Feb. 20 83 Petrochemicals: what's ahead—report. R. A. Labine (charts & tables)	Do-1t-yourself device stops barometric fluctuations. Gerhard Hubner May 15 *184
Ozone—major producer pursues new uses (chart) (N)Dec. 11 Refractory coatings prevent oxidation	80	Sept. 4 *113 Phenol—Price cut stirs up plywood ad-	Double polyethylene drums for simple calibration tank. Leslie Silverman
Oxo Alcohol	178	hesives market (N)Oct. 2 52 Phosphates	Aug. 7 *150 Double rupture disks cope with severe conditions. F. C. FranksMay 15 *182
Aldox process—Humble's modified oxo route to higher alcohols (N).Dec. 11 Monsanto to start integrated produc-	70	Ammoniated phosphates—three current developments (chart) (N) May 15 *68	Easy-to-build metering pump carries corrosives, Macbeth & Raddle.Oct. 2 *122
tion at Chocolate Bayou plant (N) May 1	36	Phosphate fertilizer helps fireproof forests (N)	Elevator moves on track to charge three reactorsOct. 30 *136 Eliminate contamination of Ziegler-
Oxygen gaining in steel and chemical markets (N)	48	Trimethyl phosphate (TMP) may go into paints, plasticsSept. 18 86 Phosphoric Acid	catalyst components. Ford & Kiss Aug. 7 *148
tries, pursues new uses (chart) (N) Dec. 11		Supercharged phosphoric acids poise for takeoff (chart & table) (N)	Eliminate dust from piston effect.
₆ P		Superphosphoric acid production at TVA's Wilson Dam, Ala., plant—	Emergency filter-cloth support made of wood. R. E. LeonardMar. 20 *180 Empirical equation for non-Newtonian
Packed-tower costs CE Cost File 54.		flowsheet. M. M. Striplin, Jr. Sept. 18 *160	Equation predicts vapor pressures.
W. F. WrothJuly 10 Packaging—Polyethylene films are clear	166 82	Phosphorus—Sale of phosphorus com- pounds sets fast pace (chart) (N) July 24 72	John Rudkin (table) Apr. 17 202 Estimate water of saturation. Ramon Oliu Mar. 20 *174
and toughMar. 6 Packing Reciprocating-rod packings need not	0.5	Phthalic anhydride—Molten anhydride and new liquid-handling system	Falling-film exchanger adapts to acid dilution. T. M. GoldmanDec. 25 96
be trouble spots. Walter Coopey	*113	speed processing (chart) (N).Mar. 6 64 Pidgeon process produces commercial magnesium—flowsheet. B. E. Barnes	actors. G. M. Machwart (chart)
Teflon-impregnated asbestos makes low-price packingJan. 23	*98	magnesium—nowsneet. B. E. Barnes May 29 *70 Pigments	Apr. 17 204 Filter prevents blackened lead welds. S. Harel
Epoxy-rubber paints for protective coatings	106	Azo pigments—How to make azo pigments—flowsheetJan. 9 *74	Filter prevents blackened lead welds. 204 S. Harel Fluorescent tube illuminates turbidity problem. E. F. Symons Sept. 4 1150 Graphical method converts mole tweights. S. I. Atallah
Linseed oll paint vehicle is water- soluble	92	ments—flowsheet	weights. S. I. AtallahApr. 17 *200 Graphical method finds logarithmic
Zinc-clad steelsFeb. 6 Robot paints metal surfaces—toy trac-	66	Pigment proves its rust-fighting properties (N)	Craphical method for showing four
tor shows how (N)Sept. 4 Scorched paint "logs" fire tempera- turesOct. 16	*74	ment vehicle	variables. W. A. MasonOct. 30 *134 Increasing accuracy of planimeter measurements. S. N. Srivastava
Paper Board—forming board is stretchy, has		Dowding & Russell (charts & tables) Oct. 30 *97	Lead ring gives tight seal in packed
no asphalt	78 76	Pipes Bands, called Miter Seal, let stainless- jacketed insulation cover fittings	columns. B. B. KlimaAug. 7 *146 Liquid solder to attach backing screens. E. C. CurranNov. 27 136
base	84	CE Cost File 52. Process-piping ma-	surized lines. Einar Wikstrom
strength	54	terials. Otto Mendal (tables) May 15 190 Du Pont building plant to manufacture	Manifold sizing and pipe scaleup done graphically. Bernard Kouzel. July 10 *160
nuclear steam supply (N) Sept. 4 Outlook—CPI capsule forecasts for '61	74	Delrin plastic pipe (N)Sept. 4 63 Flanged joints for liquid-metal service.	water content of gas. Frank Caplan
(N)	83 68	Clifford & Burnet Sept. 18 *179 Manifold sizing and pipe scaleup done graphically. Bernard Kouzel (P.N.)	Sept. 4 *154 Nomograph finds available net positive suction head. Alan Stevenson Dec. 25 100
Patents-Foreign patents costly to main-	54	Non-Newtonian fluid-flow scaleup.	Nomograph gives density of moist or dry air. F. CaplanOct. 30 136
tain (N)	82	R. L. Bowen, Jr. see Fluids Pipeline system will link Delaware Valley plants (N)	Nomograph gives diffusion rate in dilute solutions. J. F. Kuong June 12 *258 Nomograph gives reaction time or re-
Competition sharpens in chlorinated solvents (chart & table) (N).Oct. 30	62	Plastic pipe-coating becomes hig busi-	actor size. H. B. KendallFeb. 20 *168 Physical properties of allyl alcohol summarized. E. M. Braun (table)
Huels perchloroethylene process (N) Jan. 9	*52	ness	summarized. E. M. Braun (table) Dec. 25 102 Physical properties of ethanol in rapid
form disperses anickly Oct 9	58	Stainless steel jacket protects pipe- line insulationAug. 21 *146 Teflon liner repairs corroded pipe at	roundup. William Shulman (table) May 15 *186
Pesticides—Japanese antibiotic checks rice plant pest	52	*Hanford Atomic Products. Campbell & Kingsley	Polyethylene bottle makes emergency scoop. A. A. MacankaDec. 25 98 Polyethylene film releases concrete
Aromatics—coke-oven producers move to counter oil (N)June 26 Benzene-from-petroleum: more and	72	Teflon tape speeds pipe assembly Sept. 4 *78 Thermowell specifications—charts and	rolyethylene nim releases concrete forms
Benzene-from-petroleum: more and more (chart) (N)Mar. 6 Britain's petrochemicals boom (table)	76	tables speed task. Mohammad Bashar (P.N.)	
Conference to evaluate methods for petro plant management coming (N)	58	Unplasticized PVC withstands severe corrosion	Murtha (charts) Case 2 Jan. 23 *157, Case 3
Dec. 11 Gulf Coast vs. East Coast—will the petrochemical industry gradually	82	surized lines. Einar Wikstrom (P.N.)	Case 3 Mar. 20 178 Safe siphoning of hazardous liquids. M. Siegel Apr. 17 *200 Semiquantitative test checks for impurities, R. T. Johnson. July 10 162
move east? (chart & tables) (N)	0.4	Plant Location Gulf Coast has flurry of chemical plant	purities, R. T. JohnsonJuly 10 162 Simple device for continuous CO ₂ indication. W. H. GriesOct. 30 *130
HDA, and Hydeal processes see Hydrodealkylation	94	Petrochemicals' trend toward regional- ization—Petrochemicals report. R. A.	G. J. CarasFeb. 20 172
Isoprene process piloted by Idemitsu in Japan (N)	58	Labine (charts & tables)Sept. 4 122	Solenoid valves simplify automatic gas sampling G. F. Shea
Japan's CPI shifting into petrochemicals (tables) (N)	94	Automatic device maintains liquid nitrogen level. B. D. Fulks. Oct. 30 *132 Automatic steam siphon revisited—let-	Solvents calibrate explosives meter. W. A. Dickens (chart)Jan. 23 Spiral brush can feed or screen dry material. S. A. JonesMay 15 *188
step a big one—flowsheet. T. H. Arnold, Jr	*106	ters. Owen Bird, M. K. Pierce Nov. 27 *138	Table calculates change of concentra-
starts major output with Hydeal process—flowsheet	*70	Calculate pressure drop for flowing gases from tables. Frank Lipinski (tables)	tion vs. time. Frank Lerman. Dec. 25 96 Tags and magnet date stored material. C. F. Bean
		ES-*Illustrated; (N) News; (P.N.) Plant Notebo	

	muc	A to von oo, January to Decem	
Test your CEQ. Robert Lemlich . Jan.		Pipe-coating becomes big business	***
Test your CEQ. Robert Lemlich. Jan. 23-159, Feb. 20-168, Mar. 20-178, Apr. 17-198, May 15-184, June 12-256, July 10-160, Aug. 7-148, Sept. 4-152, Oct. 2-124, Oct. 30-134, Nov. 27 Theoretical plates with no equilibrium plot. Ferdinand Rodriguez. June 17 Thermistor interface control. Frederick	;	Plastic-clad steel plate—Lukens inno-	
10-160, Aug. 7-148, Sept. 4-152, Oct. 2-124, Oct. 30-134, Nov. 27	136	vation Plastic grids ease paper mill's waste-	
Theoretical plates with no equilibrium plot. Ferdinand RodriguezJune 12	*256	disposal problems (N)Aug. 21 Plastics industry founds institute for	
Thermistor interface control. Frederick	159	research (N)	
Fahnoe (chart) Jan. 25 Fahnoe (chart) Jan. 25 Fahnoe (chart) Lan. 25 Farnostatic trap makes addated transiphon. M. K. Pierce June 12 Two ideas com line or versatile tank transiphon. Nov. 27 Farnostation K. J. Johnson. Nov. 27 Farnostatic trap for mulck, unit	•254	resistant scrubber	11
Two ideas combine for versatile tank	•134	markets (chart & table) (N). May 1 Polycarbonate film	•9
Unitized investments for quick unit	196	Polycarbonate filmDec. 11 Polyesters see Polyesters Polyether—Penton, Hercules Powder's	
Unitized investments for quick unit costs. G. C. LammersApr. 17 Use curves for heat transfer. Ved	*158	chlorinated polyether-flowsheet	*11
Use curves for heat transfer. Ved Swarp Gupta Jan. 23 Use these one-step equations to find reboiler and condenser duty. J. L. Beckner Feb. 20	-100	Polyethers from propylene oxide for	6
Beckner	*164	PVC—unplasticized PVC piping with-	5
Beckner Feb. 20 Use this simple organic chemistry shorthand. Robert Lemlich Mar. 20	•178	Polyethers from propylene oxide for use in urethane foam. Feb. 6 PVC—unplasticized PVC piping withstands corrosion Jan 9 Porosity opens way to new uses for	•7
Versatile scrub tower removes halogen off-gases. John HolmesDec. 25	92	plastics (N) Dec. 11 Printing plates of Dycril in full-scale production (N) Nov. 13	
off-gases. John Holmes Dec. 25 Vibrating screw pushes solids into vacuum reactor system. A. N. John-	*124	production (N)Nov. 13 Reinforced plastics for corrosive service. R. M. Webster (charts) Pt 1 June 26 *154, Pt 2 July 10	
son & othersOct. 2 Zinc dust improves polyethylene coatings. N. E. WilsonFeb. 20	170	June 26 *154, Pt 2 July 10 Stack—giant self-supporting plastic	•16
	110	stack Sept. 4 Standards for plastics should get more	*16
CE Cost File 48, 49, 50. Cost-capacity data. Berk & Haselbarth. Pt II Jan. 23-161, Pt III Feb. 20 *174, Pt IV Mar. 20		U. S. support (N)	2
Mar. 20	*182	fluoride film	8
CE Cost File 53. Construction labor units. R. T. Witherspoon, Jr.	000	Plating Pre-electroplating bathJune 12	11:
June 12 Construction costs can be cut by adapting old methods (N). Aug. 21 Construction schedules improve work	262	Gold salts improve electroplating of transistors	8
Construction schedules improve work.	76	Platinum—Consumption up; outlook good Feb. 6	13
J. W. Hackney Apr. 3 Design and train for cold weather operations. Troyan & Threlkeld (tables). Dec. 11	•155	Plywood-Phenol price cut stirs up ply-	5
operations. Troyan & Threlkeld (tables)	164	Pneumatic or electronic instruments?	•6:
(tables) Dec. 11 Disaster control demands a pre- planned program—report Aug. 7 Evployees plant put under tons of	•111	wood agnesives market (N). Oct. 2 Pneumatic or electronic instruments? (N) Nov. 27 Polyamides: prospects for the future— Progress in high-polymer science. Polyark & Atlas (tables) Dec. 11	0,
Explosives plant put under tons of earth for safety (N)Mar. 20 Guatemalan jungle refinery built from	•96	Mark & Atlas (tables)Dec. 11 Polybutadiene	143
	*10	Cis-polybutadiene rubber plant grafted	
(N)Jan. 9 Hints for plant startup. J. E. Troyan Pt II Troubleshooting new equip-	•42	onto styrene-butadiene line at Good- rich-Gulf (chart) (N)June 26 Coating protects insides of tin cans	60
Pt II Troubleshooting new equip- ment	147	Polycarbonates	84
Pt III More on troubleshooting new equipment	91	Clear polycarbonate for lenses, goggles July 24	84
	*94	Resin is base for motion-picture films Dec. 11	*96
Oct. 16 Increase your plant profitability by decreasing capital cost. C. E. Carroll	04	Polychloromethyl oxetane—how Hercules Powder makes Penton—flowsheet	
Nov. 27 Inventory—semiannual inventory of	•113	Polyesters Jan. 23	•112
new plants and facilities (tables) Apr. 17-167-176, Oct. 16-191,	202	Corrosion-resistance of different poly- esters varies widely, tests show	
New materials: better plant repairs Mar. 6	144	Further test results (chart)June 12	182
Plant designers need better data from equipment makers. P. J. Baukol		Polyester packed-columns control air pollution. F. W. Arndt (tables)	
Systems engineering. T. J. Williams	*171	Six resin formulations fill widely	*146
See under Engineering		varying demands Dec. 25 Polyethylene	43
Union Tank Car's ten-story "turtle" covers 2½ acres	•78	Black polyethylene resists light, moistureJan. 23	96
Oct. 16	*1.68	Blow-molding process triples output of polyethylene bottles (N)Dec. 11	84
Plasticizers Andipate estersOct. 16 Expoxidized oil plasticizer for PVC	114	Cellular construction provides thinner, tougher insulation Aug. 7	80
May 1	56	tougher insulation	100
Oxo alcohol production integrated at new Monsanto plant (N)May 1	36	high-polymer science. Mark & Atlas	149
chloride	82	(tables)	143
Plastics Celcon, Celanese's new acetal resin Apr. 3	.110	Pining becomes stronger can be ex-	44
"Chemosphere" house promotes plas-	110	truded faster Dec. 25 Polyethylene bids for intercontinental cables Mar. 6	89
tics for residential structures (N) Apr. 17 "Chemospheres"—fiber-glass and plas-	•134	Polyethylene bottle makes emergency scoop. A. A. Macanka (P.N.). Dec. 25 Polyethylene latex	98
tic spheres for chemical storage Oct. 30	8149	Polyethylene latexJune 12 Shipping—hopper cars gain favor for	•108
Coating process sprays plastic and		Shipping—hopper cars gain favor for bulk hauls (N). Sept. 18 Skating rink gives polyethylene sup- porting role and Nov. 13 Vulcanizable" polyethylene for clear	70
reinforcing fibers simultaneously Oct. 16 Delrin challenges light metals markets	*222	porting role	•130
Apr. 3	*110	Polyisoprene-French route to isoprene	82
Du Pont building plant to manufacture Delrin pipe (N)Sept. 4 Foams, halogens, plastics face soaring	63	widens prospects in synthetic rubber market. Helen Avati (chart & table)	
construction market (N)Sept. 18 Inorganic-polymer chemistry points	80	Polymers (N)	• 42
way to high-temperature plastics.	•117	Inorganic-polymer chemistry points way to high-temperature plastics.	
G. Barth-WehrenalpOct. 30 Inventory—semiannual inventory of new plants and facilitiesApr. 17	173	G. Barth-WehrenalpOct. 30 The organic semiconductor challenge.	*117
Inventory—semiannual inventory of new processes and technology	* • • •	H. A. Pohl (chart & tables). Oct. 30	104
Latex coating called DaranJuly 10	126 84	Mark & Atlas (tables)Dec. 11 Polyolefins—Polyolefin fibers: their syn-	143
Latex—commercial polyethylene latex	*108	high-polymer science. Mark & Atlas	
Latex-terpolymer latex Oct. 16	114	(tables)	143
Lustran, lightweight ABS plastic, is easy to process	94	Adhesives—new application Oct. 2	•62
Forecast for '61 reportJan. 9 Outlook—CPI capsule forecasts for '61	88	mercially by Hercules Powder (N) Feb. 20	92
(N)Feb. 20	82	Modified polypropyleneNov. 13	128

1 *182

*148

74

	to	VOI.	00,	Ja	nuar	y to	Decen	iber .
	Pip	e-coat	ing	beco	mes	big b	usiness Mar. 6 ens inno-	*144
	Pla	stic-el	ad s	teel	plate-	-Luk	ens inno-	*210
	Pla	stic g	rids	ease	pape	r mill	Apr. 17 's wasteAug. 21 titute for	*70
	Pla	stics	indu	stry	found	s inst	itute for Mar. 20	100
	Pla	stics	repla	ce n	etals	for c		
	Pla	stics	take	des	d ai	m at	corrosion- May 1 metals')May 1 Dec. 11 Powder's vsheet Jan. 23	44
	Pol.	yearbo	nate s see	film	vester		Dec. 11	•90
	Pol	yether hlorina	-Pe	nton,	Here	cules —flow	Powder's	•
	Pol	yether	s fr	om 1	propyl	ene o	Jan. 23 oxide for	*112
	PV	e in the	ureth dasti	ane cized	foam. PVC	pipi	Feb. 6 ng_with-	64
	Por	ands	corre	s wa	y to	new	Jan. 23 oxide for Feb. 6 ng with Jan. 9 uses for Dec. 11 fuli-scale Nov. 13 ive serv- ts) Pt 1 2 July 10 plastic	58
	Pri	nting	plate	s of	Dycr	il in	full-scale	*72 118
	Rei	nforce	d pla	astics	for	corros	ive serv-	110
	Sta	k—gi	Ju	ine 2	6 *15	Pt :	July 10 plastic . Sept. 4	*168
	Ted	S. su lar.	wear	t (N	i) resista	int	Sept. 4 get more Dec. 25 polyvinyl	28
	Vin	vl see	film	und	er Vir	ıyl	. Aug. 21	80
	Pre	electr	onla	ting	hath		June 12	112
	Gold	i salt ansist	s in	nprov	e ele	ctropl	ating of Sept. 18 ook good	84
								134
P	w	ood ac	lhesi	ves r	narke	t (N)	up ply- Oct. 2	52
P	(l	mides:	pro	anec	ta for	the	Nov. 27 future— science. Dec. 11	*62
	P	rogres	s in	his as (t	h-pol	ymer	science. Dec. 11	143
	or ri	ito sty	rene	-buta	(N)	line	t grafted at Good- .June 26 tin cans	60
								84
Pe	Clea	rbona r poly	tes carb	onat	e for	lenses	goggles	0.4
							July 24 ure films Dec. 11	*90
Pe	lyel	lorom	ethy	loxe	tane-	-how	Margulas	
Pe	lves	ters	ma	nes	ento	n10	wsheet Jan. 23	•112
	Cori	osion- esters	resis vai	tance ries	of o	differe	Jan. 23 nt poly- ts show . Apr. 3 .June 12 ntrol air (tables) Nov. 27	
	F	(chart irther	test	resu	lta (c	hart).	Apr. 3	182 272
	Poly	ester llution	pacl n. 1	ked-c	olumr V. A	ns cor rndt	(tables)	****
			fo	rmul	ations	fill	Nov. 27 widely . Dec. 25	*146
Po	lyet	hytene				resists		10
	m	oisture	ling	nroce	one tri	nles o	Jan. 23 utput of	96
								84
1	Film	ugher rele	insu ases	lation	rete	forms	Aug. 7	80
	Metl	nods (of m	anuf	acture	-Pro	thinner. . Aug. 7 (P.N.) Dec. 25 gress in	100
							& Atlas Dec. 11 tough	143
								82
1	tru	ded f	aster ne l	ids	for in	tercor	be ex- Dec. 25	44
1	ca	bles ethyle	no l	ottle	mak	es en	Mar. 6	82
	800	00p. A	. A.	maca	nka (P.N.)	. Dec. 25	98 •108
*	Ship	ping— lk ha	hop)	oer c	ars g	ain fa	June 12 avor for Sept. 18 ne sup-	7.0
	po	ing ri rting caniza	role				NOV. 13	*130
20	0 415	oal in	aulat	tion			or elec- July 24 isoprene	82
U	Wi	dens p	rosp	ects	in syr	thetic	isoprene rubber & table) May 29	
o	(N)					May 29	• 42
	nor	ganic-	him	h tor	nmann	nistry ture	points plastics.	
7	G.	Barth	ic s	hrenico	alp	or ch	oct. 30 science. Dec. 11 eir syn- ress in & Atlas	*117
1	H.	A. Poress	hl (chart	& ta	bles). mer	oct. 30 science.	104
o	yole	fins—	Poly	s (ta olefin	fiber	s: the	Dec. 11 eir syn-	143
	hig	h-pol	nd ymer	prope	nce. 1	-Prog Mark	& Atlas	143
o	ypr	pylen	e					
Æ	ld he	SIVes-	-new	lypro	pylen	e mad	le com-	•62
	me	relaily	ру	Her	cures	LOWC	Feb. 20	92

Monofilament used as sweeper bristle Nov. 13	****
Novamont Corp., Neal, W. Va., plant on stream (N)Nov. 27 Polypropylene booming—Eastman's and	*126 *66
Progress in high-polymer science.	143
Tensile strength increases with hexing	100
Polystyrene — Outlook — prospects in flercely competitive world market (charts) (N)	68
Polyurethane Black polyurethane elastomer. Aug. 7 Foams see under Foams	82
Texin, urethane elastomerApr. 3 Urethane floor finish dries in humid	111
Black polyurethane elastomer. Aug. 7 Foams see under Foams Texin. urethane elastomer. Apr. 3 Urethane floor finish dries in humid Sept. 4 Polyvinyl alcohol pushes for big markets (N) Aug. 21 Potash	78 66
Potash Producers step up capacity to meet climbing demand (charts & tables) (N)	0.0
(N)Oct. 16 Solution mining technique to get try	98
(N) Oct. 16 Solution mining technique to get try in Saskatchewan (N) May 15 Powder Metallurgy—Alumina powder, called Baymal, forms stable colloid June 26	72
Tuno 96	76
Precipitation—Acoustic precipitation—Cultrasonic report. Pt. R. M. G. Boucher (charts & tables)Oct. 2 Presses, hydraulic—CE Cost File 51. R. O. Bathiany (chart)Apr. 17	*84
R. O. Bathiany (chart)Apr. 17	194
Pressure Calculate pressure drop for flowing gases (tables) Frank Lipinski (P.N.) July 10 Disks—how to size safety disks. E.M. Diss & others	101
Disks—how to size safety disks. E. M. Diss & others	*187
conditions F. C. Franks (P. N.)	
Equation predicts vapor pressures, John	*182
Equation predicts vapor pressures, John Rudkin (P.N.) (table)Apr. 17 High-pressure chemistry, R. H. Wentorf, Jr. (charts & tables)Oct. 16 Low-pressure process yields pure, high pressure introgen—flowsheet.Nov. 13	*177
Low-pressure process yields pure, high- pressure nitrogen—flowsheet.Nov. 13	*180
Walter Coopey	*113
lower cost. E. R. Driskell (charts & tables)	*246
plates (N)	118
Low-pressure process yields pure, high- pressure nitrogen—flowheet. Nov. 13 Packing—Reciprocating-rod packings. Walter Coopey Aux. 21 Steam distribution: better control at lower cost. E. R. Driskell (charts & tables) Nov. 13 Printing plates—Du Pont starts full- scale production of Dycril plastic plates (N) Nov. 13 Process Equipment Mfrs. Assn. (PEMA) —Meet PEMA Sept. 18 Plant designers need better data from equipment makers. P. J. Baukol— with PEMA's reply Sept. 18	174
Production	171
Production Are your department's costs meaningful? W. H. RichardsonMay 29 Costs—estimate production costs faster with summary forms. J. W. Hackner, 17 Design, and train for cold weather	*108
Apr. 17 Design and train for cold weather operations. Troyan & Threlkeld	*179
operations Troyan & Threlkeld (tables) Hits for plant startup, J. E. Troyan II. Troubleshooting new equipment of the plant startup of the plant startup of the plant startup.	164
Pt II. Troubleshooting new equipment	147
C. D. HendrixDec. 11	153
where without "can-do". W. H. Richardson Jan. 9	•124
Richardson Jan. 9 Propylene carbonate rids natural gas of excess CO2 (N) May 29 Pseudocumene commercially produced to the commercial of the commer	50
Public Relations—Disaster control— mutual aid programs provide planned	110
report	*116
Pulp and Paper Acetic and formic acids recovered from	
sulfite liquor by unique process (charts) (N)	*124
(charts) (N)	100
pulp (N)	106
Czechs claim improved wood-pulping	100
process (N) Dec. 11 Inventory—semiannual inventory of new plants and facilitiesApr. 17	86
new plants and facilitiesApr. 17 Inventory—semiannual inventory of	175
new processes and technology Jan. 23 Ion exchange processes ease sulfite liquor problems (chart) (N). Aug. 7 Paper industry sees bright future despite luli (N)	127
Paper industry sees bright future	70
despite luli (N)Aug. 7 Pollution control progress reported (N)Mar. 20	68 96
(N) Mar. 29 Potlatch's computer-controlled paper machine promises profits (N). Dec. 11 Ridding kraft-mill effluent of unwanted color (chart) (N)Nov. 13	84
wanted color (chart) (N)Nov. 13	110

МΙ

Pumps Are canned pumps for you? W. T.				Tunitan hanna blandan miras salid fuel	
		Coatings protect refractory metal (tables)	1 178	Trailer-borne blender mixes solid fuel on site (chart) (N)June 26	*66
Korzuch (chart & table) May 1	95	Mullite-bonded corundum brick resist:	R .	Ultrasonics may help increase and con-	0.0
		thermal shockFeb. 2	*105	trol solid propellants' burning rate— Ultrasonics report. R. M. G. Boucher	
Design air chambers to control pressure pulsation. Carl Jahreis (P.N.)	210	Oxides to pace ceramics growth (ta	-	Ultrasonics report. R. M. G. Boucher	200
Design air chambers to control pres-		ble) (N)July 2	4 78	United Technology Corp. tests solid-	-99
Sept. 4 *1	50	Refrigeration		fueled engine (N) Sept. 18	*76
Easy-to-build metering pump carries		Desalinization pilot plant shows freez ing process (N)Oct. 10	106	fueled engine (N)Sept. 18 Rockets and Missiles	
Easy-to-build metering pump carries corrosives. Macbeth & Raddle (P.N.)		Liquid gases for mobile refrigeration-	-	Filament winding to add more punch	
Oct. 2 *1	22	Chemetron's CO2 system and Linde's	4	to Minuteman (N)Dec. 25 Lubes anticipate space demands (N)	*32
CE Cost File 57: Pump and com-	28	Polarstream (N)Oct.	52	Mar. 6	*59
pressor costs Oct. 2 1 High-vacuum systems—estimate costs	20	Neon-liquid neon makes ideal refrig-	60	NASA and Rocketdyne Test Stand for	9.5
graphically, C. H. Naundori (charts)		erant Jan. Zone freezing: Quantum's new chemi		F-1 liquid-fuel engineJune 12	*106
Oct. 2 *1	07	cal purification process (N) Nov 1	118	Rocket propulsion-reports. F. J. Hen- del (charts & tables)	
Nomograph finds available NPSH.	0.0	Research		Chemical rocket—propulsion systems	
Alan Stevenson (P.N.) Dec. 25 1 Selecting pumps and compressors.	00	Chemstrand Research Center opens in	1	Mar. 6	*99
Younger & Ruiter (charts). June 26 *1	17	North Carolina	•102	Advanced rocket propulsion. Apr. 3	
Standards for pumps in the CPI-		Conference on the New Chemical En-		Exotic rocket-propulsion systems	
Standards report, R. V. Hughson		gineering—see under Engineering Corrosion researchers confer at 1st In-		July 24	*135
Nov. 13 *2	12	ternational Congress on Metallic Cor-		Rubber Bitumen rubber for low-cost caulking	
Troubleshooting new equipment— Plant startup. Pt 3. J. E. Troyan		rosionJune 1:	*68	of construction joints Mar. 20	104
May 1	92	Directory tells where to go for scientific information (N)Dec. 25		Butyl latex commercially available	
Purchasing—Evaluating quantity dis- counts. G. E. HapstoneMar. 6 *1		tific information (N)Dec. 25	3.9	July 24	84
counts. G. E. Hapstone Mar. 6 *1	17	Drug research spending hits new high (N) Aug. 21	72	Cis-polybutadiene plant grafted onto	
Purification Solid-state-chemistry methods yield		Erosion studies use supersonic water		Gulf (chart) (N) June 26	60
ultrapure materials. R. E. Johnson		jets Sept. Sept. Federal funds for R&D Apr. Government asks step-up in engineer	*164	styrene-butadiene line at Goodrich- Gulf (chart) (N)June 26 Fluid silicone rubber solidifies quickly	011
(charts)Jan. 23 *1	47	Federal funds for R&DApr.	162	at 77 F	*84
Ultrapure materials produced by new				Fluorinated rubber coating, called	
zone-refining and crystal-growing methods. R. E. Johnson (charts)		ing effort	144	Fluorel, makes fabries corrosion-	***
methods. R. E. Johnson (Charts) Jan. 23 *1	47	Retrieval		resistant	*84
Zone freezing: Quantum's new chemical	* 1	Lubes anticipate space demands (N)		new plants and facilities Apr. 17	175
purification process (N), Nov. 13 1	18	Mar. (*59	Inventory — semiannual inventory of	
		New Trends in Chemistry Conference— see under Chemistry		new processes and technology.Jan. 23	126
0		Operations research: a progress report		Isoprene process piloted by Japanese refiner, Idemitsu (N)Mar. 6	f p
Q		J. C. Hetrick (table)Jan 23	137	Outlook—CPI capsule forecasts for '61	58
		Plastics industry founds institute for		(N)Feb. 20	83
Quartz-Pure-fused quartz from domes-		research (N)	100	Overseas rubber markets spur carbon	
tic SiO ₂	92	R & D expenditures on the rise (tables)	76	black growth (chart & tables) (N)	
		(N)		June 26	62
R		by Lionel's T R Medaris (N) Aug 7	*74	Polysulfide rubber molds reproduce fine	*104
Radiation		Southwest Research Institute and CE to co-sponsor conference on petroplant management methods (N)		sculpture	
Hallam, Neb., nuclear plant will soon		to co-sponsor conference on petro		fabrics to rubber	56
have radiation available for process-		plant management methods (N) Dec. 11	82	Silicone rubber welds metalsMay 1 Specialties to offset drop in exports (N)	*59
ing. E. G. Lowell (charts & tables)		U. S. to release more OTS R&D reports	0.2	Specialties to offset drop in exports (N) Sept. 18	80
Aug. 21 *1 Is radiation chemistry practical? P. Y.	07	(N)June 12	98	Specialty rubbers for special uses	80
Feng Dec. 25	67	Resin		Pt I Design data for gaskets and	
Radioactivity		Acetal resins are denting metals' mar-		seals made of new elastomers	
Decontamination process permits repair		kets	•110	(charts) Sept. 18	*204
of damaged equipment (N). Mar. 6	60	Celcon, Celanese's new acetal resin Apr. 3	•110	Pt II Chemical resistances of various	*139
Hazards—design: key to minimizing		Cotton boosted by easy-care resin fin-	110	specialty rubbers (table)Oct. 2 Stereo or stereospecific rubber—see Cis-	192
plant radiation hazards. L. J. Cheru- bin. Pt 2	63	ishes (N)	62	polybutadiene	
Radioisotopes help solve CPI engineer-		Diluent simplifies formulation of epoxy		Synthetic rubber outlook-Forecast for	
ing problems, Overman & Rohrman		resins	128	'61 reportJan. 9	87
	51	Epoxies for mament winding Oct. 2	42	Russia	
(tables)		Enory lacquer Dec 95			
Railways	-	Epoxy Jacquer Dec. 25	84	Chemical industry growing fast (N)	104
Aluminum tubular hopper cars will		Epoxy lacquer Dec. 25 Filament-winding epoxy July 16 Inventory — semiannual inventory of	84	Apr. 3	104
Aluminum tubular hopper cars will	74	Financh Figure F	84	Apr. 3 Distillation practice lags behind re-	104
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 • Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18		Epoxy lacquer Dec. 2s Filament-winding epoxyJuly 16 Inventory — semiannual inventory of new plants and facilitiesApr. 17 Inventory — semiannual inventory of	173	Apr. 3 Distillation practice lags behind research (N)	136
Railways Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk poly- ethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls	74 70	Epoxy lacquer Dec. 29. Dec. 29. Tilament-winding epoxy July 10. Inventory — semiannual inventory of new plants and facilities Apr. 17. Inventory — semiannual inventory of new processes and technology. Jan. 23.	173	Apr. 3 Distillation practice lags behind research (N)	136 *131
Railways Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk poly- ethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4	74	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables)	84 178 126	Apr. 3 Distillation practice lags behind re- search (N) EJC's visiting team reports on Russia's engineers Mineral strength gains (N) Feb. 6	136
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique	74 70 66	Epoxy lacquer Dec. 25 Filament-winding epoxy July 16 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology.Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25	84 178 126	Apr. 3 Distillation practice lags behind re- search (N)	136 *131
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (N)Aug. 7 Rare Earths—Samarium sulfide boosts	74 70	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset, epoxy resin, repairs leaking	84 178 126 *73	Apr. 3 Distillation practice lags behind re- search (N) EJC's visiting team reports on Russia's engineers Mineral strength gains (N) Feb. 6	136 *131 48
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankear hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankear (N)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators	74 70 66 74	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 7 Inventory — semiannual inventory of new plants emiannual inventory of new formation of the control of the control Inventories of the control	84 178 126	Apr. 3 Distillation practice lags behind re- search (N)	136 *131 48
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (N)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators May 1	74 70 66	Epoxy lacquer Dec. 25 Filament-winding epoxy July 16 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology.Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tablec. 25 Metalset. epoxy resin, repairs leaking drums	84 178 126 *73	Distillation practice lags behind research (N)	136 *131 48
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar haus cryosenic materials (N)Sept. 18 cryosenic materi	74 70 66 74	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset. epoxy resin, repairs leaking drums . Sept. 4 One-component epoxies based on molec- ular sleves . Nov. 27 Phenolic resin . July 24 Phenolic resin . July 24	84 173 126 *73 162	Apr. 3 Distillation practice lags behind re- search (N)	136 *131 48
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets universely and the super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets universely construction of the super-insulation of the super-in	74 70 66 74	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and memboraes. H. P. Gregor (charts & table) Dec. 25 Metalset, epoxy resin, repairs leaking drums Sept. 4 One-component epoxies based on molec- ular sieves Nov. 27 Phenolic resin July 24 Phenolic resin make heat-resistant	84 173 126 *73 162 *68 86	Distillation practice lags behind re- search (N)	136 *131 48
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (N)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators May 1 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Designing temperature-stable reactors	74 70 66 74	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and memboraes. H. P. Gregor (charts & table) Dec. 25 Metalset, epoxy resin, repairs leaking drums Sept. 4 One-component epoxies based on molec- ular sieves Nov. 27 Phenolic resin July 24 Phenolic resin make heat-resistant	84 173 126 •73 162 •68	Distillation practice lags behind re- search (N)	136 *131 48
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (X) Law-temperature ammonia gets unique tankcar (X) Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators efficiency of thermoelectric generators Tripple 2 (chart) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables)	74 70 66 74 54	Epoxy lacquer Dec. 25 Filament-winding epoxy July 16 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables, 25 Metalset, epoxy resin, repairs leaking drums	84 173 126 *73 162 *68 86 80	Distillation practice lags behind research (N)	136 *131 48 54
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (N)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators May 1 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15	74 70 66 74	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset. epoxy resin, repairs leaking drums — Sept. 4 One-component epoxies based on molec- ular sieves — Nov. 27 Phenolic resins make heat-resistant laminates — June 26 Phenolics speed curing of foundry cores	84 173 126 *73 162 *68 86 80 74	Distillation practice lags behind re- search (N)	136 *131 48
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (X)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators (Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 18 Restore Restore Reter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank re-	74 70 66 74 54 70	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset, epoxy resin, repairs leaking drums — Sept. 4 One-component epoxies based on molec- ular sieves — Nov. 27 Phenolic resins make heat-resistant laminates — June 26 Phenolics speed curing of foundry cores — Oct. 20 Polycarbonate resin is base for motion- nicture films — Dec. 11	84 173 126 *73 162 *68 86 80 74	Apr. 3 Distillation practice lags behind re- search (N)	136 *131 48 54
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (X) Aux. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators efficiency of thermoelectric generators Payon—Tire cord upturn; reversal or ripple 2 (chart) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stired tank reactorsMay 29 Organic-moderated reactors rate high	74 70 66 74 54	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset. epoxy resin, repairs leaking drums	84 173 126 *73 162 *68 86 80 74	Apr. 3 Distillation practice lags behind re- search (N)	136 •131 48 54
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (N)Sept. 4 Aug. 7 Kare Earths—Samarium sulfide boosts efficiency of thermoelectric generators May 1 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power upits (charts)	74 70 66 74 54 70	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory as emiannual inventory of new plants and membranes. Inventorial properties of the poxy resines and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset, epoxy resin, repairs leaking drums . Sept. 4 One-component epoxies based on molecular sleves . Nov. 27 Phenolic resin July 24 Phenolic resin make heat-resistant laminates June 26 Phenolics speed curing of foundry cores . Oct. 30 Polycaronate resin is base for mec. Polycaronate films and polycaronate films are films of the polycaronate films of the	84 173 126 *73 162 *68 86 80 74 *98	Apr. 3 Distillation practice lags behind research (N)	*131 *48 54 *68 142 *111
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (A)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 18 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsAug. 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)Mar. 20May 29	74 70 66 74 54 70	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory as emiannual inventory of new plants and membranes. Inventorial properties of the poxy resines and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset, epoxy resin, repairs leaking drums . Sept. 4 One-component epoxies based on molecular sleves . Nov. 27 Phenolic resin July 24 Phenolic resin make heat-resistant laminates June 26 Phenolics speed curing of foundry cores . Oct. 30 Polycaronate resin is base for mec. Polycaronate films and polycaronate films are films of the polycaronate films of the	84 173 126 *73 162 *68 86 80 74	Apr. 3 Distillation practice lags behind research (N)	136 •131 48 54
Maitways Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk poly- ethylene shipments (X)Sept. 18 Linde's super-insulated tankcar hauls Low-temper materials (N)July 10 Low-temper materials (N)July 10 Low-temper materials (N)July 10 Ray Company (N)July 10 Ray (Earths—Samarium sulfide boosts efficiency of thermoelectric generators May 1 Rayon—Tire cord upturn: reversal or ripple? (charl) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charls & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank re- actors Jay (N) Sodium-graphite reactor at Hallam (N) Sodium-graphite reactor at Hallam	74 70 66 74 54 70	Epoxy lacquer Dec. 25 Filament-winding epoxy July 16 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) e. 25 Metalset, epoxy resin, repairs leek. 25 drums Sept. Oncomponent epoxies based on molecular sleves — July 24 Phonolic resins make heat-resistant laminates — June 26 Phenolic speed curing of foundry cores — Oct. 29 Polycarbonate resin is base for motion- nicture films — Dec. 12 Polycepter formulations fill widely vary- ing demands — Dec. 25 Polycethers from propylene oxide for use in urchane foam — Feb. 6	84 173 126 *73 162 *68 86 80 74 *98	Apr. 3 Apr. 3 Apr. 17 EJC's visiting team reports on Russia's engineers	*131 48 54 *68 142 *111 116
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (A)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators (Bayon—Tire cord upturn: reversal or ripple? (chart) (N)July 18 RescorsAug. 19 RescorsAug. 19 RescorsAug. 10 Pt. 2 Packed-bed and stirred tank reactors	74 70 66 74 54 70	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 37 Inventory as emiannual inventory of new plants and facilities. Apr. 37 Inventorial semiannual inventory of Inventorial semiannual inventory of Inventorial semiannual inventory of Inventorial semiannual inventory of Inventorial semiannual inventorial inve	84 173 126 *73 162 *68 86 80 74 *98 112 48	Apr. 3 Apr. 3 Apr. 17 EJC's visiting team reports on Russia's engineers	*131 48 54 *68 142 *111 116
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (A)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Retorn Peter Harriott (charts & tables) Pet. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)Mar. 20 Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. G. Lowell (charts & tables)Aug. 2, 21	74 70 666 774 554 655 831	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Metalset. epoxy resin, repairs leaking drums	84 173 126 *73 162 *68 86 80 74 *98 112 48	Apr. 3 Apr. 3 Apr. 17 EJC's visiting team reports on Russia's engineers	*131 48 54 *68 142 *111 116
Malitways Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 48 cryog	74 70 666 774 554 655 831	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Metalset. epoxy resin, repairs leaking drums	84 173 126 *73 162 *68 86 80 74 *96 112 43	Apr. 3 Apr. 4 Apr. 17 EJC's visiting team reports on Russia's engineers Aug. 21 Mineral strength gains (N) Feb. 6 Nuclear energy achievements (N) Oct. 2 S Safety American Cyanamid's vast safety network covers HCN in transit (N) Sept. 18 CE to participate in NIDM Disaster Control Conference Mar. 6 Disaster control—report based on experts' panel discussion Aug. 7 Unit process—safety audit Aug. 7 Unit process—safety measures in hazardous process areas—report . R. W. Scott (charts & tables) July 10 Explosion suppression: new safety tool. C. B. Hammond Dec. 25	*131 48 54 *68 142 *111 116
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (X)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Rescors Reper temperature-stable reactors Pet 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)Mar. 20 Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. G. Lowell (charts & tables)Aug. 21 Refining Blending at Union Oil uses turbine me-	74 770 666 774 760 770 770 770 770 770 770 770 770 770	Epoxy lacquer Dec. 25 Filament-winding epoxy July 16 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Metalset, epoxy resin, repairs leaking drums	84 173 126 *73 162 *68 86 80 74 *98 112 48	Apr. 3 Distillation practice lags behind research (N)	*131 48 54 *68 142 *111 116
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (N)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 P. 2 Recked-bed and stirred tank reactorsCord as ship and power units (charts) (N)Mar. 20 Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. G. Lowell (charts & tables)Aug. 21 Refining Blending at Union Gil uses turbine meters, all-digital control (N)May 29 California oil refineries complete smog	74 70 666 774 554 655 831	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jan. 22 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset. epoxy resin, repairs leaking drums — Sept. 4 One-component epoxies based on molec- ular sieves — Nov. 27 Phenolic resins make heat-resistant laminates — July 24 Phenolic resins make heat-resistant laminates — June 26 Phenolics speed curing of founds Polycophonate resin is base for motion- neiture films — Dec. 25 Polycarbonate resin is base for motion- neiture films — Dec. 25 Polycarbonate resin semi base for motion- ling demands — Dec. 25 Polycarbonate resins — See 16 Polycopromaldehyde resins—see Acetal resins Polyguifide-epoxy formulations, called Tipox, for coatings, adhesives. Jan. 9 Self-extinguishing efficiency of epoxies Improved by bromine halogenation	84 173 126 *73 162 *68 86 80 74 *96 112 48 64	Apr. 3 Apr. 4 Apr. 17 EJC's visiting team reports on Russia's engineers	*131 48 54 *68 142 *111 116
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar hauls cristen per partition of the section of the	74 770 666 774 760 770 770 770 770 770 770 770 770 770	Epoxy lacquer Dec. 25 Filament-winding epoxy July io Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membraes. H. P. Gregor (charts & tab Dec. 25 Metalset, epoxy resin, repairs leaking drums . Sept. 4 One-component epoxies based on molec- ular sieves Nov. 27 Phenolic resin July 24 Phenolic resin make heat-resistant laminates June 26 Phenolics speed curing of foundry cores Oct. 30 Polycarbonate resin is base for motion- nicture films Dec. 17 Polycepter formulations fill widely vary- ing demands Dec. 25 Polycarbonate resin is base for use in urethane foam — Dec. 25 Polycarbonate resin is base for use in urethane foam — Sept. 4 Polycalide-epoxy formulations, called Tipox, for coatings, adhesives, Jan. 9 Self-extinguishing efficiency of epoxies improved by bromine halogenation Jan. 23	84 173 126 *73 162 *68 86 80 74 *96 112 43	Apr. 3 Apr. 3 Apr. 17 EJC's visiting team reports on Russia's engineers	*131 48 54 *68 142 *111 116 *123 85 *96
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (N)Supt. 4 Low-temperature ammonia gets unique tankcar (N)Supt. 4 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)May 29 Organic-moderated reactors rate high as ship and power units (charts) (N)May 29 Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. 6. Reflanced (charts & tables)Aug. 21 Reflanced (charts & tables)Aug. 21 California oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction	774 770 666 774 760 765 760 774 770 770 770 770 770 770 770 770 77	Epoxy lacquer Dec. 25 Filament-winding epoxy July id Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jun. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset. epoxy resin, repairs leaking drums — Sept. 4 One-component epoxies based on molec- ular sieves — Nov. 27 Phenolic resins make heat-resistant laminates — July 24 Phenolic resins make heat-resistant laminates — June 26 Phenolics speed curing of foundry cores Porter films is base for motion Polycopoxides — Oct. 16 Polyceter formulations fill widely vary- ing demands — Dec. 25 Polyethers from propylene oxide for use in urchane foam — Feb. 6 Polyformaldehyde resins—see Acetal resins Polyguifide-epoxy formulations, called Tipox, for coatings, adhesives. Jan. 9 Self-extinguishing efficiency of epoxies Improved by bromine halogenation Jan. 23 Styrene-maleic anhydride resins modify	84 173 126 *73 162 *68 86 80 74 *98 112 48 64	Apr. 3 Distillation practice lags behind research (N)	*131 48 54 *68 142 *111 116 *123 85
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (N)Supt. 4 Low-temperature ammonia gets unique tankcar (N)Supt. 4 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)May 29 Organic-moderated reactors rate high as ship and power units (charts) (N)May 29 Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. 6. Reflanced (charts & tables)Aug. 21 Reflanced (charts & tables)Aug. 21 California oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction program (N)Sept. 4 Canadian Oil refineries complete smog refunction	774 770 666 774 760 765 774 770 770 770 770 770 770 770 770 770	Epoxy lacquer Dec. 25 Filament-winding epoxy July id Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jun. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset. epoxy resin, repairs leaking drums — Sept. 4 One-component epoxies based on molec- ular sieves — Nov. 27 Phenolic resins make heat-resistant laminates — July 24 Phenolic resins make heat-resistant laminates — June 26 Phenolics speed curing of foundry cores Porter films is base for motion Polycopoxides — Oct. 16 Polyceter formulations fill widely vary- ing demands — Dec. 25 Polyethers from propylene oxide for use in urchane foam — Feb. 6 Polyformaldehyde resins—see Acetal resins Polyguifide-epoxy formulations, called Tipox, for coatings, adhesives. Jan. 9 Self-extinguishing efficiency of epoxies Improved by bromine halogenation Jan. 23 Styrene-maleic anhydride resins modify	84 173 126 *73 162 *68 86 80 74 *96 112 48 64	Apr. 3 Distillation practice lags behind research (N)	*131 48 54 *68 142 *111 116 *123 85 *96 *132
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (N)Supt. 4 Low-temperature ammonia gets unique tankcar (N)Supt. 4 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Facked-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)May 29 Sodium-graphite reactor at Hatlam nuclear plant which will make radian under plant which will make radian available for processing. E. G. 18 Refining Blending at Union Oil uses turbine meters, all-digital control (N)May 29 California oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refinery scened to hydrocarbons trend—flowsheetOct. 16 Catalysis, Vladimir HaeneslNov. 27 11 Catalysis Vladimir HaeneslNov. 27 11 Catalysis, Vladimir HaeneslNov. 27 11 Catalysis Vladimir HaeneslNov. 27 11 Catalysis Vladimir HaeneslNov. 27 11 Catalysis Vladimir HaeneslNov. 2	774 770 666 774 760 765 774 770 770 770 770 770 770 770 770 770	Epoxy lacquer Dec. 25 Filament-winding epoxy July in Inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & table) and the processes and technology. Jan. 26 Metalset, epoxy resin, repairs leaking drums Sept. 4 One-component epoxies based on molecular sleves Nov. 27 Phenolic resin July 24 Phenolic resins make heat-resistant laminates June 26 Phenolics speed curing of foundry cores Oct. 26 Phenolics speed curing of foundry cores Oct. 27 Phenolic resins is base for motion-nicture films Dec. 17 Polyceptor formulations fill widely varying demands Dec. 25 Polycethers from propylene oxide for use in urethane foam Feb. 6 Polyformaldehyde resins—see Acetal resins. Polysulfide-epoxy formulations, called Tipox, for coatings, adhesives, Jan. 9 Self-extinguishing efficiency of epoxies improved by bromine hologenation fan. 23 Styrene-maleic anhydride resins modify latex paint May 1 Water-soluble, synthetic resins push for big markets (charts & tables) (N)	84 173 126 *73 162 *68 86 80 74 *96 112 48 64 58	Apr. 3 Distillation practice lags behind research (N)	*131 48 54 *68 142 *111 116 *123 85 *96
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar hals Linde's super-insulated tankcar hals Low-temperature amanda gets unique tankcar (N)	74 70 666 774 55 55 55 55 57 77 66 66 774	Epoxy lacquer Dec. 25 Filament-winding epoxy July id Inventory — semiannual inventory of new plants and facilities. Apr. 17 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Metalset, epoxy resin, repairs leaking drums — Sept. 4 One-component epoxies based on moles ular sleves — Nov. Phenolic resins make heat-roststal Phenolic resins make heat-roststal Phenolic resins make heat-roststal Perolics speed curing of foundry Polycopides of the proposition	84 173 126 *73 162 *68 86 80 74 *98 112 48 64	Apr. 3 Distillation practice lags behind research (N)	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets universelve tankcar (A) Low-temperature ammonia gets universelve tankcar (A) Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N) Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. G. Landing at Union Oil uses turbine meters all-digital control (N)May 29 California oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete sm	74 70 666 774 55 55 55 55 57 77 66 66 774	Epoxy lacquer Dec. 25 Filament-winding epoxy July id Inventory — semiannual inventory of new plants and facilities. Apr. 7. Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membraes. H. P. Gregor (charts & table) Gregor (charts & table) Gregor (charts & table) Grums — Sept. 4 One-component epoxies based on molecular sieves — Nov. 27 Phenolic resin — July 24 Phenolic resin — July 24 Phenolic resin make heat-resistant laminates — June 26 Phenolics speed curing of foundry cores — Oct. 30 Polycarbonate resin is base for motion-nicture films — Dec. 17 Polycuptides — Oct. 16 Polycster formulations fill widely varying demands — Dec. 25 Polycarbonate resin is base for use in urchane foam — Feb. 6 Polyformaldehyde resins—see Acetal Tipox, for coatings, adhesives Jan. 9 Self-extinguishing efficiency of epoxies improved by bromine halogenation Jan. 23 Styrene-maleic anhydride resins modify latex paint	84 173 126 *73 162 *68 86 80 74 *96 112 48 64 58	Apr. 3 Distillation practice lags behind research (N)	*131 48 54 *68 142 *111 116 *123 85 *96 *132
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 Cryogenic materials (N)Sulp 10 Cryogenic materials (N)Sulp 10 Cryogenic materials (N)Sulp 10 Cryogenic materials (N)Sept. 18 Cryogenic materials (N)Sept. 18 Cryogenic materials (N)Sept. 18 Cryogenic materials (N)Sept. 19 Cryogenic materials (N)Sept. 19 Cryogenic materials (N)Sept. 19 Cryogenic materials (N)Sept. 19 Cryogenic materials (N)Sept. 18 Cryogenic materials	774 779 666 774 774 770 774 770 774 770 774 774 774	Epoxy lacquer Dec. 25 Filament-winding epoxy July id Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Metalset. epoxy resin, repairs leaking drums . Sept. 4 One-component epoxies based on moles ular sieves . Nov. 29 Phenolic resins make heat-resistant laminates . July 2 Phenolic resins make heat-resistant laminates speed curing of oundry corles speed curing of oundry polycoprosides . Dec. 15 Polycotromalterial based on moles in urchane foam . Dec. 15 Polycotromalterial based on moles in urchane foam . Dec. 25 Polycarbonate resins base for motion- nicture films . Dec. 11 Polycoprovides . Oct. 16 Polycotromaldehyde resins—see Acetal resins Polyguifide-epoxy formulations, called Tipox, for coatings, adhesives, Jan. 8 Self-extinguishing efficiency of epoxies Improved by bromine halogenation Jan. 23 Styrene-maleic anhydride resins modify latex paint . May 1 Water-soluble, synthetic resins push for big markets (charts & tables) (N) Rocket Propellauts Aerojet's solid-fuel motor segments	84 173 126 *73 162 *68 86 80 74 *98 64 58 98 52	Apr. 3 Distillation practice lags behind research (N)	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (A) Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N) Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. G. Lowell (charts & tables)Aug. 21 Refining Blending at Union Oil uses turbine meters, all-digital control (N)May 29 California oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries complete sunog reduction program (N)Sept. 4 Canadian Oil refineries com	774 779 666 774 774 770 774 770 774 770 774 774 774	Epoxy lacquer Dec. 25 Filament-winding epoxy July id Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & table). 25 Metalset, epoxy resin, repairs leaking drums Sept. 4 One-component epoxies based on molec- ular sleves Nov. 27 Phenolic resin July 24 Phenolic resin make heat-resistant laminates June 26 Phenolics speed curing of foundry cores Oct. 26 Phenolics speed curing of foundry cores Oct. 26 Phenolics speed curing of foundry cores Oct. 26 Polycarbonate resin is base for motion- nicture films Dec. 17 Polyceptor formulations fill widely vary- ing demands Dec. 25 Polycarbonate resin is base for use in urethane foam Feb. 6 Polyformaldehyde resins—see Acetal resins Polysulfide-epoxy formulations, called Tipox, for coatings, adhesives, Jan. 9 Self-extinguishing efficiency of epxics improved by bromine halogenation for the plants of the plants of the plants I water-soluble, synthetic resins poush for big markets (charts & tables) (N) Aug. 21 Rocket Propellants Aerojet's solid-fuel motor segments grow fatter (N) Oct. 2	84 173 126 *73 162 *68 86 80 74 *96 112 48 64 58	Apr. 3 Apr. 3 Apr. 13 Bistillation practice lags behind research (N)	136 *131 48 54 *68 142 *111 116 *96 *123 *94
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (A)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 18 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)Mar. 29 Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. G. Lowell (charts & tables)Aug. 21 Refining Blending at Union Oil uses turbine meters, all-digital control (N)May 29 California oil refineries complete smog reduction program (N)Sept. 4 Canadan Oil refineries complete smog reduction program (N)Sept. 4 Canadan Oil refinery geared to hydrocarbons trend—flowsheetOct. 16 Catalysis. Vladimir HaenselNov. 27 HDA and Hydeal processes—see Hydrodeals, and processes weet refiners' changing needs (chart & tables) (N) New fuel test may replace old ocarber rests	774 779 666 774 554 679 655 531 532 77 666 677 677 678 679 679 679 679 679 679 679 679 679 679	Epoxy lacquer Dec. 25 Filament-winding epoxy July id Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) Metalset. epoxy resin, repairs leaking drums . Sept. 4 One-component epoxies based on moles ular sieves . Nov. 29 Phenolic resins make heat-resistant laminates . July 2 Phenolic resins make heat-resistant laminates speed curing of oundry corles speed curing of oundry polycoprosides . Dec. 15 Polycotromalterial based on moles in urchane foam . Dec. 15 Polycotromalterial based on moles in urchane foam . Dec. 25 Polycarbonate resins base for motion- nicture films . Dec. 11 Polycoprovides . Oct. 16 Polycotromaldehyde resins—see Acetal resins Polyguifide-epoxy formulations, called Tipox, for coatings, adhesives, Jan. 8 Self-extinguishing efficiency of epoxies Improved by bromine halogenation Jan. 23 Styrene-maleic anhydride resins modify latex paint . May 1 Water-soluble, synthetic resins push for big markets (charts & tables) (N) Rocket Propellauts Aerojet's solid-fuel motor segments	84 173 126 *73 162 *68 86 80 74 *98 64 58 98 52	Apr. 3 Distillation practice lags behind research (N) Apr. 17 EJC's visiting team reports on Russia's engineers Aug. 21 Mineral strength gains (N) Feb. 6 Nuclear energy achievements (N) Oct. 2 S Safety American Cyanamid's vast safety network covers HCN in transit (N) Sept. 18 CE to participate in NIDM Disaster Control Conference Mar. 6 Disaster control—report based on experts' panel discussion Aug. 7 Unit process—safety audit Aug. 7 Unit process—safety audit Aug. 7 Electrical safety measures in hazardous process areas—report. R. W. Scott EXPLOSIVES Weathers (N) EXPLOSIVES Weathers (N) EXPLOSIVES Weathers (N) EXPLOSIVES Weathers (N) EXPLOSIVES Planting the Lagrange (N) Mar. 20 Flammable vapors ousted by jet (N) Hazards of water, air in process aystems—two booklets offered. Mar. 6 Hurricane Carla—how good planning prevented major damage to Gulf Coast plants (N) in chemical process industries. R. L. Jacks (charts & tables) Feb. 20	136 *131 48 54 *68 142 *111 116 *96 *123 *94
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (A)Aug. 7 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 18 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)Mar. 29 Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. G. Lowell (charts & tables)Aug. 21 Refining Blending at Union Oil uses turbine meters, all-digital control (N)May 29 California oil refineries complete smog reduction program (N)Sept. 4 Canadan Oil refineries complete smog reduction program (N)Sept. 4 Canadan Oil refinery geared to hydrocarbons trend—flowsheetOct. 16 Catalysis. Vladimir HaenselNov. 27 HDA and Hydeal processes—see Hydrodeals, and processes weet refiners' changing needs (chart & tables) (N) New fuel test may replace old ocarber rests	774 779 666 774 554 679 655 531 532 77 666 677 677 678 679 679 679 679 679 679 679 679 679 679	Epoxy lacquer Dec. 25 Filament-winding epoxy July 10 Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory as emiannual inventory of new plants and facilities. Apr. 71 Inventory as emiannual inventory of new plants and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset, epoxy resin, repairs leaking drums	84 178 126 *73 162 *68 80 74 *96 112 48 64 58 98 52 66 *54 67	Apr. 3 Distillation practice lags behind research (N) Apr. 17 EJC's visiting team reports on Russia's engineers Aug. 21 Mineral strength gains (N) Feb. 6 Nuclear energy achievements (N) Oct. 2 S Safety American Cyanamid's vast safety network covers HCN in transit (N) Sept. 18 CE to participate in NIDM Disaster Control Conference Mar. 6 Disaster control—report based on experts' panel discussion Aug. 7 Unit process—safety audit Aug. 7 Unit process—safety audit Aug. 7 Electrical safety measures in hazardous process areas—report. R. W. Scott EXPLOSIVES Weathers (N) EXPLOSIVES Weathers (N) EXPLOSIVES Weathers (N) EXPLOSIVES Weathers (N) EXPLOSIVES Planting the Lagrange (N) Mar. 20 Flammable vapors ousted by jet (N) Hazards of water, air in process aystems—two booklets offered. Mar. 6 Hurricane Carla—how good planning prevented major damage to Gulf Coast plants (N) in chemical process industries. R. L. Jacks (charts & tables) Feb. 20	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *127
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (A)Sample 2 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 18 Resident (N)July 18 Resident (N)July 19 Resident (N)July 19 Pt. 2 Packed-bed and stirred tank reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsJuly 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)	74 70 66 74 74 75 85 85 85 83 83 83 83 83 83 83 83 83 83 83 83 83	Epoxy lacquer Dec. 25 Filament-winding epoxy July in Inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & table). 25 Metalset, epoxy resin, repairs leaking drums	84 178 126 *73 162 *68 86 74 *96 112 48 64 58 98 52 66	Apr. 3 Distillation practice lags behind research (N) Apr. 17 EJC's visiting team reports on Russia's engineers Aug. 21 Mineral strength gains (N) Feb. 6 Nuclear energy achievements (N) Oct. 2 S Safety American Cyanamid's vast safety network covers HCN in transit (N) Sept. 18 CE to participate in NIDM Disaster Control Conference Mar. 6 Disaster control—report based on experts' panel discussion Aug. 7 Unit process—safety audit Aug. 7 Unit process—safety audit Aug. 7 Electrical safety measures in hazardous process areas—report. R. W. Scott EXPLOSIVES Weathers (N) EXPLOSIVES Weathers (N) EXPLOSIVES Weathers (N) EXPLOSIVES Weathers (N) EXPLOSIVES Planting the Lagrange (N) Mar. 20 Flammable vapors ousted by jet (N) Hazards of water, air in process aystems—two booklets offered. Mar. 6 Hurricane Carla—how good planning prevented major damage to Gulf Coast plants (N) in chemical process industries. R. L. Jacks (charts & tables) Feb. 20	136 *131 48 54 *68 142 *111 116 *96 *123 *94
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (A)Sample 2 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 18 Resident (N)July 18 Resident (N)July 19 Resident (N)July 19 Pt. 2 Packed-bed and stirred tank reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsJuly 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)	74 70 66 74 74 75 85 85 85 83 83 83 83 83 83 83 83 83 83 83 83 83	Epoxy lacquer Dec. 25 Filament-winding epoxy July io Inventory — semiannual inventory of new plants and facilities. Apr. 7 Inventory — semiannual inventory of new plants and facilities. Apr. 7 Inventory — semiannual inventory of new plants and membranes. H. P. Gregor (charts & tables) Metalset, epoxy resin, repairs leaking drums . Sept. 4 One-component epoxies based on molec- ular sieves . Nov. 27 Phenolic resin July 24 Phenolic resins make het-resistant laminates June 26 Phenolics speed curing of foundry cores . Oct. 39 Polycarbonate resin is base for motion- microperion . Dec. 11 Polyport formulations fill widely vary- log demands . Dec. 25 Polysthers from propylene oxide for use in urethane foam . Feb. 6 Polyformaldehyde resins—see Acetal resins Polysulfide-epoxy formulations, called Tipox, for coatings, adhesives, Jan. 9 Self-extinguishing efficiency of epoxies improved by bromine halogenation Jan. 23 Styrene-maleic anhydride resins push for big markets (charts & tables) (N) Rocket Propellants Acrojet's solld-fuel motor segments grow fatter (N) . Oct. 2 Aluminum powder use gains (N) "Sectional charge" method uses solid	84 178 126 *73 162 *68 86 80 112 48 64 58 98 59 66 *54 67 43	Apr. 3 Distillation practice lags behind research (N)	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *127
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (A)Sept. 4 Low-temperature ammonia gets unique tankcar (A)Sept. 4 Rare Earths—Samarium sulfide boosts efficiency of thermoelectric generators. Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors. Designing temperature-stable reactors. Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts) (N)Mar 29 Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. G. Lowell (charts & tables)Aug. 2 Refining Blending at Union Oil uses turbine meters, all-digital control (N)May 29 California oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refinery geared to hydrocarbons trend—flowsheetOct. 16 Catalysis. Undimir HaenselNov. 27 HDA and Hydeal processes—see Hydrocarbons trend—flowsheetOct. 16 Catalysis. Undimir HaenselNov. 27 HDA and Hydeal processes meet refiners' changing needs (chart & tables) (N) New fuel test may replace old octane rating methods, cut blending costs (N) Feb. 6 Petrochemicals: what's ahead? Petrochemicals report. R. A. Labine (charts & tables)	74 70 66 74 74 75 85 85 85 83 83 83 83 83 83 83 83 83 83 83 83 83	Epoxy lacquer Dec. 25 Filament-winding epoxy July in Inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tablec, 25 Metalset, epoxy resin, repairs leaking drums	84 178 126 *73 162 *68 80 74 *96 112 48 64 58 98 52 66 *54 67	Apr. 3 Apr. 3 Apr. 17 Search (N)	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *127
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets unique tankcar (A)Sept. 18 Low-temperature ammonia gets unique tankcar (A)Sammonia gets (A)	74 70 66 74 74 75 85 85 85 83 83 83 83 83 83 83 83 83 83 83 83 83	Epoxy lacquer Dec. 25 Filament-winding epoxy July in Inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tablec. 25 Metalset. epoxy resin, repairs leaking drums	84 178 126 *73 162 *68 86 80 112 48 64 58 98 59 66 *54 67 43	Apr. 3 Distillation practice lags behind research (N)	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *127
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets universelve the control of the contro	74 70 66 74 74 55 55 55 55 55 55 55 55 55 55 55 55 55	Epoxy lacquer Dec. 25 Filament-winding epoxy July io Inventory — semiannual inventory of new plants and facilities. Apr. 7 Inventory — semiannual inventory of new plants and facilities. Apr. 7 Inventory — semiannual inventory of new processes and technologists. 23 Ion-exchange resins and monares. 25 Metalset, epoxy resin, repairs leaking drums . Sept. 4 One-component epoxies based on molecular sleves . Nov. 27 Phenolic resin . July 24 Phenolic resins make heat-resistant laminates . June 26 Phenolics speed curing of foundry cores . Oct. 39 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 46 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 46 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 36 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 36 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 36 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 36 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 36 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 36 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 36 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 36 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 37 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Dec. 11 P	84 178 126 *73 162 *68 86 80 74 48 64 58 98 52 66 *54 67 43 104	Apr. 3 Apr. 3 Apr. 17 EJC's visiting team reports on Russia's engineers	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *127 *127
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets universelve the control of the contro	74 70 66 74 74 55 55 55 55 55 55 55 55 55 55 55 55 55	Epoxy lacquer Dec. 25 Filament-winding epoxy July in Inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new plants and facilities. Apr. 71 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables. 25 Metalset, epoxy resin, repairs leaking drums	84 178 126 *73 162 *68 80 74 *96 112 48 64 58 59 66 *54 67 43 49 49 49 49 49 49 49 49 49 49	Apr. 3 Distillation practice lags behind research (N)	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *127 *127
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (N)Sept. 18 Linde's super-insulated tankcar hauls cryogenic materials (N)Sept. 4 Low-temperature ammonia gets universelve the control of the contro	74 70 66 74 74 55 55 55 55 55 55 55 55 55 55 55 55 55	Epoxy lacquer Dec. 25 Filament-winding epoxy July in Inventory of new plants and facilities. Apr. 7 Inventory — semiannual inventory of new plants and facilities. Apr. 7 Inventory — semiannual inventory of new processes and technology. Jan. 23 Ion-excharge resins and men. Apr. 25 Metalset. epoxy resin, repairs leaking drums . Sept. 4 One-component epoxies based on molecular sleves . Nov. 27 Phenolic resin . July 24 Phenolic resin make heat-resistant laminates . June 26 Phenolics speed curing of foundry cores . Oct. 39 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 46 Polycoster formulations fill widely vary ing demands . Dec. 26 Polycarbonate resin is base for motion-nicture films . Dec. 11 Polycapoxides . Oct. 46 Polyformaldehyde resins—see Acetal resins Polyculfide-epoxy formulations, called Tipox, for coatings, adhesives, Jan. 9 Self-extinguishing efficiency of epoxies Improved by bromine halogenation Jan. 23 Styrene-maleic anhydride resins modify latex paint . May 1 Water-soluble, synthetic resins push for big markets (charts & tables) (N) Rocket Propellants Acrojet's solid-fuel motor segments grow fatter (N)	84 178 126 *73 162 *68 80 74 *96 112 48 64 58 59 66 *54 67 43 49 49 49 49 49 49 49 49 49 49	Apr. 3 Distillation practice lags behind research (N)	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *127 *127
Maliways Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar haus cryosenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryosenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryosenic materials (N)Sept. 18 cryosenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryosenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryosenic materials (N)Sept. 18 Ray 17 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high a ship and power units of the stables of the super-insulation available for processing. E. G. Lowell (charts & tables)Aug. 21 Refining Blending at Union Oil uses turbine meters, all-digital control (N)May 29 California oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Catalysis. Utadimir HaenselNov. 27 May 1 New fuel test may replace old octane rating methods, cut blending costs (N) New fuel test may replace old octane rating methods, cut blending costs (N) New fuel test may replace old octane rating methods, cut blending costs (N) New fuel test may replace old octane rating methods, cut blending costs (N) New fuel test may replace old octane rating methods, cut blending costs (N) New fuel test may replace old octane rating methods, cut blending costs (N) New fuel test may replace old octane rating methods, cut blending costs (N) New fuel test may replace old octane rating methods, cut blending costs (N) New fuel test may replace old octane rating methods, cut blending costs (N) New fuel test may replace old octane ra	74 76 66 67 74 65 66 66 67 67 67 67 67 67 67 67 67 67 67	Epoxy lacquer Dec. 25 Pilament-winding epoxy July io Inventory — semiannual inventory of new plants and facilities. Apr. 71 In me plants and facilities. Apr. 71 In me plants and facilities. Apr. 71 In me processes and echnology Jan. 23 Ion-exchange resins and membranes. H. P. Gregor (charts & tables) — Dec. 25 Metalset, epoxy resin, repairs leaking drums Sept. 4 One-component epoxies based on molecular sieves Nov. 27 Phenolic resin	84 178 126 *73 162 *68 80 74 *96 112 48 64 58 59 66 *54 67 43 104 *98 *131	Apr. 3 Apr. 3 Apr. 17 EJC's visiting team reports on Russia's engineers	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *94 *127 *127 *127 *127
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 cryogenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 cryogenic materials (N)Sept. 18 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts & salien) Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. G. Lowell (charts & tables)Aug. 21 Refining Blending at Union Oil uses turbine meters, all-digital control (N)May 29 California oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Catalysis. Vladimir HaenselNov. 27 HD Australia methods, cut blending costs (N)	74 76 66 67 77 66 67 67 67 67 67 67 67 67	Epoxy lacquer Dec. 25 Pilament-winding epoxy July io Inventory of new plants and facilities. Apr. 71 Inventory of semiannual inventory of new plants and facilities. Apr. 71 Inventory of semiannual inventory of new plants and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset, epoxy resin, repairs leaking drums Sept. 4 One-component epoxies based on molecular sleves Nov. 27 Phenolic resin July 24 Phenolic resins make heat-resistant laminates June 26 Phenolics speed curing of foundry cores Oct. 39 Polycarbonate resin is base for motors of foundry cores Oct. 39 Polycarbonate resin is base for motors of the polycarbonate resin is base for motors of the polycarbonate resin is base for motors of the polycarbonate resin is base for motors of Polycarbonate resins in the polycarbonate resin is base for motors of Polycarbonate resins of the polycarbonate polycarbonate resins of the polycarbonate resins modify latex paint water-soluble, synthetic resins would for big markets (charts & tables) (X) Rocket Propellants Actoric's solid-fuel motor segments grow fatter (N) Oct. 2 Auminum powder use gains (N) "Sectional charge" method uses solid fuels (N) "Sectional charge" method uses solid fuels (N) "Sectional charge" method uses solid fuels (N) "Rocket Propulsion—reports F. J. Hendel (Charts	84 178 126 *73 162 *68 80 74 *96 112 48 64 58 59 66 *54 67 43 104 *131 *135	Apr. 3 Apr. 17 EJC's visiting team reports on Russia's engineers	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *127 *127
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 cryogenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 cryogenic materials (N)Sept. 18 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Rayon—Tire cord upturn: reversal or ripple? (chart) (N)July 10 Reactors Designing temperature-stable reactors Peter Harriott (charts & tables) Pt. 1 Tubular reactorsMay 15 Pt. 2 Packed-bed and stirred tank reactorsMay 29 Organic-moderated reactors rate high as ship and power units (charts & salien) Sodium-graphite reactor at Hallam nuclear plant which will make radiation available for processing. E. G. Lowell (charts & tables)Aug. 21 Refining Blending at Union Oil uses turbine meters, all-digital control (N)May 29 California oil refineries complete smog reduction program (N)Sept. 4 Canadian Oil refineries complete smog reduction program (N)Sept. 4 Catalysis. Vladimir HaenselNov. 27 HD Australia methods, cut blending costs (N)	74 76 66 67 74 65 66 66 67 67 67 67 67 67 67 67 67 67 67	Epoxy lacquer Dec. 25 Pilament-winding epoxy July io Inventory of new plants and facilities. Apr. 71 Inventory of semiannual inventory of new plants and facilities. Apr. 71 Inventory of semiannual inventory of new plants and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset, epoxy resin, repairs leaking drums Sept. 4 One-component epoxies based on molecular sleves Nov. 27 Phenolic resin July 24 Phenolic resins make heat-resistant laminates June 26 Phenolics speed curing of foundry cores Oct. 39 Polycarbonate resin is base for motors of foundry cores Oct. 39 Polycarbonate resin is base for motors of the polycarbonate resin is base for motors of the polycarbonate resin is base for motors of the polycarbonate resin is base for motors of Polycarbonate resins in the polycarbonate resin is base for motors of Polycarbonate resins of the polycarbonate polycarbonate resins of the polycarbonate resins modify latex paint water-soluble, synthetic resins would for big markets (charts & tables) (X) Rocket Propellants Actoric's solid-fuel motor segments grow fatter (N) Oct. 2 Auminum powder use gains (N) "Sectional charge" method uses solid fuels (N) "Sectional charge" method uses solid fuels (N) "Sectional charge" method uses solid fuels (N) "Rocket Propulsion—reports F. J. Hendel (Charts	84 178 126 *73 162 *68 80 74 *96 112 48 64 58 59 66 *54 67 43 104 *98 *131	Apr. 3 Apr. 3 Apr. 17 EJC's visiting team reports on Russia's engineers	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *94 *127 *127 *127 *127
Aluminum tubular hopper cars will haul bulk chemicals (N)July 10 Hopper cars gain favor for bulk polyethylene shipments (X)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 cryogenic materials (N)Sept. 18 Linde's super-insulated tankcar haus cryogenic materials (N)Sept. 18 Linde's super-insulated tankcar chause can	74 770 666 774 755 755 755 757 757 757 757 757 757	Epoxy lacquer Dec. 25 Pilament-winding epoxy July io Inventory — semiannual inventory of new plants and facilities. Apr. 7 Inventory — semiannual inventory of new plants and facilities. Apr. 7 Inventory — semiannual inventory of new plants and membranes. H. P. Gregor (charts & tables) — Dec. 25 Metalset, epoxy resin, repairs leaking drums Sept. 4 One-component epoxies based on molecular sleves Nov. 27 Phenolic resin	84 178 126 *73 162 *68 80 74 *96 112 43 64 58 98 52 66 *54 67 43 104 *131 *135 44	Distillation practice lags behind research (N)	106 *131 48 54 *68 142 *111 116 *123 *85 *96 *132 142 *94 *127 *127 *128 *86
Aluminum tubular hopper cars will haul bulk chemicals (N). July 10 Hopper cars gain favor for bulk polyethylene shipments (X) Sept. 18 Linde's super-insulated tankcar haus crossente materials (N) Sept. 18 Crossente materials (N) July 10 Crossente materials (N) May 15 Crossente materials (N) May 29 Crossente materials (N) Sept. 4 Crossente	74 76 66 67 77 66 67 67 67 67 67 67 67 67	Epoxy lacquer Dec. 25 Pilament-winding epoxy July io Inventory of new plants and facilities. Apr. 71 Inventory of semiannual inventory of new plants and facilities. Apr. 71 Inventory of semiannual inventory of new plants and membranes. H. P. Gregor (charts & tables) Dec. 25 Metalset, epoxy resin, repairs leaking drums Sept. 4 One-component epoxies based on molecular sleves Nov. 27 Phenolic resin July 24 Phenolic resins make heat-resistant laminates June 26 Phenolics speed curing of foundry cores Oct. 39 Polycarbonate resin is base for motors of foundry cores Oct. 39 Polycarbonate resin is base for motors of the polycarbonate resin is base for motors of the polycarbonate resin is base for motors of the polycarbonate resin is base for motors of Polycarbonate resins in the polycarbonate resin is base for motors of Polycarbonate resins of the polycarbonate polycarbonate resins of the polycarbonate resins modify latex paint water-soluble, synthetic resins would for big markets (charts & tables) (X) Rocket Propellants Actoric's solid-fuel motor segments grow fatter (N) Oct. 2 Auminum powder use gains (N) "Sectional charge" method uses solid fuels (N) "Sectional charge" method uses solid fuels (N) "Sectional charge" method uses solid fuels (N) "Rocket Propulsion—reports F. J. Hendel (Charts	84 178 126 *73 162 *68 80 74 *96 112 48 64 58 59 66 *54 67 43 104 *131 *135	Apr. 3 Distillation practice lags behind research (N)	136 *131 48 54 *68 142 *111 116 *123 85 *96 *132 142 *94 *127 *127 *127 *127

NOTES-*Illustrated; (N) News; (P.N.) Plant Notebook

el 26 *66 ner 2 *99 1-18 *76

h 25 *32 1) 6 *59 or 12 *106

4 *135 E 104

> *68 142

*128 85 *96 *132 *94 *127 *163 *200 *172 *132

104

Cement pastes meet high-temperatur sealing needs	*54 *179 7 *146 3 *258 1 142 *78	Solar energy sparks new hope for under-developed areas (N)Oct. 16 1 Solder Hydrazine flux in core solder won't cor-	180 *96 104	Plastic-clad steel plate—Lukens innovation Apr. 17 Precipitation-hardening stainless tanks for rocket fuels. John Halbig, Dec. 25 Stainless steel for CPI equipment—forecast to 1967 (N) Mar. 6 Stainless steel jacket protects pipeline insulation Aug. 21 T-1 steel—new type equals old, costs less Mar. 6 Ti-clad steel plate—Lukens' new process. R. V. Hughson May 15	148
Troubleshooting new equipment—Plan startup Pt. 3. J. E. Troyan. May Sedimentation—Design sedimentation systems from laboratory data. Conway & Edwards (charts & tables). Sept. 11 Separation Acetic and formic acids recovered from sulfite liquor by unique process (chart) (N)	91	screens. E. C. Curran (P.N.) Nov. 27 1 Solids NRC vacuum process encapsulates solids (N)	136 •52 147	Storage Ammonia—swing to storing NH ₃ cold in low-pressure tanks saves \$\$ (N) Feb. 20 Equipment—Burlap, coated with poly- ethylene, provides cheap hutments	*88 *166
Alumina plant.—Africa's first—uses re- shaped Bayer process (chart) (N. Oct.: Amylose and amylopectin commer- cially separated from corn starch Mar. (Beryllium concentrates coming via tw	*42	Solid-state chemistry gives insight in- to crystal behavior. F. V. Schoss- berger (charts & tables)Nov. 13 *2 Separation—progress in electrostatic separations. H. L. Bullock (charts) Oct. 2 *1 Sodium borohydride—solids-gas reac- tion slashes production cost. T. P. Eyerbath (charts)		Liquefied gases: cryogenic or pressure storage? N. R. Hower (charts) May 29 Spherical tanks, called "Chemispheres", for chemical storage Oct. 30 Tags and magnet date stored material C. F. Bean (P.N.)	*77
competing separation processes (chart) (N) is July 2. Cascade theory in distillation. W. D. Maclean (charts) Aug. 2! Controlling distillation columns. Bert- rand & Jones Feb. 2! Electrostatic separations — renaissance coming? H. L. Bullock (charts)	*66 123 *139	Solvents Alkaline cleaner removes rust and heavy scale	58 62	Adsorption process heads new techniques at American Sugar refinery (charts) (N)	*64
Cot. 2 Foam separation technique, developed by Radiation Applications, set to go (N)	*100 122	cess CO ₂ (N)	157	lish plant—flowsheet. T. P. Forbath Mar. 6 Sucrose esters and sugar glycerides set for commercial production (N) Mar. 20 Sulfur dioxide—Chart gives solubility of SO ₂ in ammonium bisulfite. R. A. Bonsall (P.N.)	*90
lytic purification (charts) (N) Oct. 16 Review principles of distillation. Coates & Pressburg. See "CE Refresher" Zone freezing: Quantum's new separa-	102	Rocket Propulsion—reports. Hendel (charts & tables) Chemical rocket—propulsion systems Mar. 6 Advanced rocket propulsionApr 3 *12 Exotic rocket-propulsion systems	99	Falling-film unit adapts to acid dilu- tion, T. M. Goldman (P.N.). Dec. 25 Hungary's two-stage process recovers sulfuric acid from waste Nag8o4 (N) May 29	*182 96
tion technique (N) Nov. 18 Sequestration—Metal-complex formation new data. A. E. Martell (charts & tables) Nov. 27 Shipping Cryogenic materials—Linde's super- insulated tankcar hauls liquid hydro- gen cross-country (N) Sept. 4	•95	"Space Flight Report" blueprints space	20	Surfactants Cationic surfactant for oil wells works even in salt waterFeb. 29 Lanolin-derivative surfactant yields emulsions	105 70 86
Hopper cars gain favor for bulk poly- ethylene shipping (N)Sept. 18 Liquid ethylene starts regular transit in refrigerated trailer (N)Apr. 17 Liquid methane—Conch International tells how transoceanic tanker per-	70 •136	Spray gun applies plastic and reinforeing fibers simultaneouslyOct. 16 *2: Standardization Plastics industry urged to set international standards (N)Dec. 25 Where standards stand in the CPI at home and abroad—report. R. V.	28	Sulfonated fatty acidsOct. 2 Tanks	60
formed (N) Sept. 4 Low-temperature ammonia hits the rails (N) Aug. 7 Nuclear propulsion ahead—organic re- actors rate high (charts) (N).Mar. 20 Refrigerants for trucks, railears— liquid CO ₂ , liquid nitrogen (N)	*74 *82	Hughson Nov. 13 *26 Starch Amylose and amylopectin commercially separated from corn starch Mar. 6 *1 Corn yields maze of products at Eng- lish plant—flowsheet. T. P. Forbath	80	Aluminum tank repair—manual offered May 15 Ammonia producers shift to low-pressure storage tanks (N)Feb. 20 Calibration tank made of two polyethylene drums. Leslie Silverman (P.N.)Aug. 7	198 *88 *150
Safety network guards Cyanamid's HCN over vast transit route (N) Sept. 18 Shorthand—Use this simple organic chemistry shorthand. Robert Lemlich	*68	Synthetic gums reach for starch mar- ket (charts & tables) (N)Aug. 21 (Statistics Cumulative-sum (CS) charts find fur- ther application. W. C. Mayhew	90	(P.N.) Aug. 7 (CE Cost File 55. Polyester-fiberglass tanks Sept. 4 (Chemispheres", for storage Oct. 30 (Steel tanks for rocket fuels. John Halbig. Dec. 25 (Two ideas combine for versatile tanks)	158
(P.N.) Mar. 20 Silica foam called Eccofoam Oct. 16 Silicon Electronics calls for more high-purity silicon (N) June 12 Heating rods operate up to 1700 C. Apr. 3	*94	Quick ways statistics can help you. B. S. Brown (tables)Sept. 4 *13 Statistical mechanics—statistical theory of fluid transport phenomena. J. S. DahlerJan. 9 *11	37	rwo ideas combine for versatile tank installation. K. J. Johnson (P.N.) Nov. 27 a Tantalum Protect tantalum from hydrogen embrittlement (table) Apr. 3 a Tantalum plus tungsten for high-tem-	
Masonry waterproofing agent teams boron and silicon	82 78	Automatic steam siphon revisited—letters. Owen Bird, M. K. Pierce (P.N.) Nov. 27 *13 Paper mill seeks nuclear steam supply (N) Sept. 4 Steam distribution: better control at	20	perature uses Dec. 11 Taxes—Tax credit proposal—boost for capital investment? (N) July 10 Technology Conference on the New Chemical Engineering see Engineering	182
sion resistance, M. F. Kiachif (tables) May 29 Silicones	8110	lower cost I. R Driskell (charts &		Inventory—semiannual inventory of new processes and technology	
Coatings for molds improve ingot surface qualityJan. 9 Encapsulant resin is easy to apply	60	Thermostatic trap makes automatic	62	New trends in Chemistry see Chemistry Progress in high-polymer science. Mark & Atlas (tables)Dec. 11	
face quality Jan. 9 Encapsulant resin is easy to apply Mar. 20 Fluid rubber solidifles quickly at 77 F. Fluorosilicones: built-in solvent resist- ance (chart) Oct. 30 Nitrile stilicones June 12	60	(N)	62 54 28	New trends in Chemistry see Chemistry Progress in high-polymer science. Mark & Atlas (tables)	113 74 110 110
face quality Jan. 9 Encapsulant resin is easy to apply Mar. 20 Fluid rubber solidifies quickly at 77 F. Fluorosilicones: built-in solvent resist- ance (chart) Oct. 30 Sitrile silicones June 12 Petros material lengthens life of elec- Rubber—self-bonding silicone rubber welds metals May 1 Silicone-epoxy compounds are stable at high temperatures May 15 Urethane foam has silicone additives	*104 *84 *70 108 *94 *52	(N)	62 54 28 02	New trends in Chemistry see Chemistry Progress in high-polymer science. Mark & Atlas (tables)	113 74 110 110
face quality Jan. 9 Encapsulant resin is easy to apply Mar. 20 Fluid rubber solidifies quickly at 77 F. Fluorosilicones: built-in solvent resistance (chart) Oct. 30 Nitrile silicones June 12 Potting material lengthens life of electronic components Jan. 23 Rubber—self-bonding silicone rubber welds metals May 1 Silicone-poxy compounds are stable at	*104 *84 *70 108 *94 *52	(N) 1	62 54 28 02 70 60	New trends in Chemistry see Chemistry Progress in high-polymer science. Mark & Atlas (tables)	113 74 110 110 110 *180 *156 44

Equilibrium calculation for high-tem-		U		Hungarian process recovers sulfuric acid from waste Na ₂ SO ₄ (N). May 29	42
perature combustion chambers (char- & tables). R. L. PetersAug. 7 High-temperature and plasma chem-	133	Ultrasonics		Water—Swiss heavy-water plant melds new features—flowsheetFeb. 20 *	118
istry. J. L. Margrave (tables)		Erosion studies use supersonic water jets	*164	Water Pollution CPI may face stiffer pollution laws	*10
Low-temperature vessels made of low-		Erosion studies use supersonic water jets	***	Jan 93	*78
cost carbon steel (N)Nov. 13 Tantalum plus tungsten for high-temperature usesDec. 11		Unit Operations		Du Pont's complex uses marine life to check on river pollution control (N)	***
Testing Fires model fires speed tests of ex-		Batch distillation of binary mixtures —report Benjamin Block (charts) Feb. 6		Ion exchange processes reduce paper mills' pollution problems (chart)	.00
tinguishers (N)Apr. 3 Motor fuel test may cut blending cost	106	Electrostatic separations—progress re- news interest. H. L. Bullock (charts)		Plastic grids asso paper mill's waste-	70
tinguishers (N)	*50	Oct. 2 Transport phenomena simplify trans-	*101	pollution problems (N)Aug. 21 Pulpers report progress in pollution control (N)Mar. 20	*70
namics by pulse testing. J. O. Hougen (charts)June 12	•209	fer theories. L. D. Smoot (tables) Aug. 21	126	Simple test detects water contamina-	96
namics by pulse testing. J. O. Hougen (charts) June 12 Semiquantitive test checks for impurities. R. T. Johnson (P.N.)	162	Urea Ammonia blanket gives low-biuret urea		Water repellant—Textile waterproofer	38
Tetramethyl lead-Outlook-Forecast for		Process at Kansas plant gains from	60	withstands dry-cleaning, laundering Oct. 2	60
'61 reportJan. 9 Textiles Cotton use boosted by easy-care resin	- 60	fresh ideas—flowsheetJuly 10	*116	Water Treatment Cooling—Simultaneous transfer of heat	
finishes (N)	62	V		Pressburg (charts) Pt 1 May 29	95
sublimes at 6,600 F Oct. 16	*110	Vacuum Cleaning exhaust line may solve		Desalting-add three gains to sea	151
Nonwoven, fett-like tabric called Fiberloc	86	Cleaning exhaust line may solve vacuum problem. R. H. Parekh (P.N.)	260	(chart)	86
		Degassing unit at Crucible Steel oper- ates like giant coffee maker (N) Feb. 6		plant desalts sea water (N). July 16	*76
Textile softener June 12 Waterproofing emulsion withstands dry-cleaning, laundering Oct. 2 Worth project of the control of the contro	110	High-vacuum systems-aids to graph-	*48	hydrate conversion process, and two	
weather-resistant limsh	60 72	ical cost estimation and preliminary design. C. H. Naundorf (charts)	4107	water conversion technology (N) (chart)	86
Thermodynamics Calculations for multicomponent dis-		NRC vacuum encapsulation handles wide range of particle sizes (N)	*107	shows freezing process (N)Oct. 16	106
tillation—report, R. M. Maddox Dec. 11	127	Valves	*52	Slime-producing bacteria starved by	*78
Common errors in thermodynamics. M. R. CannonAug. 7 Controlling distillation columns. Ber-	*127	Ball valves loom larger—sales makers	56	(table)Apr. 3	•90
trand & Jones Feb. 20 Graphical prediction of ternary azeotropes. P. J. Horvath (tables)	*139	(chart) (N)	137	Swimming pool bactericide won't irri- tate eyes or skin	104
tropes. P. J. Horvath (tables) Mar. 20	*159	Solenoid valves simplify automatic gas sampling. G. F. Shea (P.N.). Nov. 27	*132	tate eyes or skin	141
High-temperature and plasma chem- istry. J. L. Margrave (tables)		Dietlel phthelate vernishes Ech 90	104	Walding	141
Irreversible thermodynamics T. J.		Silicone varnish withstands heat, cures quickly	94	Aluminum-epoxy, Devcon F., welds metals in 45 minutes Jan. 23 Filter prevents blackened lead welds. S. Harel (P.N.) Feb. 29 Flux, called Tinflux, permits joining	96
Tykodi (charts)	*233	heat transfer. Robert Lemlich (chart	8171	S. Harel (P.N.)Feb. 20 *1	170
duction equation. Y. L. Luke (tables) Jan. 9 Statistical mechanics—statistical theory	*95	Vinyl PVC plastic-clad steel plate—Lukens	1.1	magnesium to stainless	192
of fluid transport phenomena. J. S. Dahier Jan. 9 Thickeners—Acrylic thickener boosts	*111	innovation	*210	"Square-butt" welding method devel- oped at Linde	132
Thickeners—Acrylic thickener boosts viscosity of aqueous systems. Sept. 4	80	Vinyl acetate emulsion is new pigment	80	oped at Linde	
Titanium Heat exchangers of titanium replacing		vehicle	*72	Wood	76
glass for chlorine cooling (table)	*170		84	Spray dryer carves chemicals out of bark (N)Dec. 11 Wood preservative—pentachlorophenol	71
Ti-clad steel plates—Lukens' new proc- ess. R. V. Hughson	*194	Vinylpyrrolidone copolymers make tough, dye-receptive filmsJune 12	110	Aug. (82
Training Design and train for cold weather operations. Troyan & Threlkeld		Viscosity Estimate viscosities by comparison		Wool—Dyeing aid	40
	164	with known materials. Alves & Brugmann (chart) Sept. 18 Tables speed viscosity conversion.	181	X	
Make management training count. R. P. BottJune 26 NSPE defines grades for certifying	*146	W. M. Underwood (tables) Aug. 21	117	Nylene Ortho-xylene challenges petronaphtha-	
	*100	W		lene as phthalic feedstock (N) May 29	48
Operating manuals—guide to prepara- tion and contents. J. E. Troyan (table)	*134	Waste Disposal		O-xylene gets towering capacity at Cities Service Lake Charles, La.	82
Ten years out? Go back to the books May 29	*102	Activated-sludge process solves waste problem at Monsanto's Alabama plant (N)		refinerySept. 18 *	00
Transport phenomena see Fluids Trichloroethane — Chlorinated solvents—	20	plant (N)	*79	Z	
competition sharpens (N)Oct. 30 Trichloroethylene—Chlorinated solvents —competition sharpens (N)Oct. 30	62 62		*66	Zeolite-Linde Co. wins CE's Kirkpatrick	
Triphenylphosphorus goes commercial Mar. 20	105	Defoamer douses syndet suds in sec- onds July 24	*82	Award for synthetic zeolite adsorb- ents (N)	46
Trucks Tank truck cases highway shipping	100	Defoamer douses syndet suds in sec- onds	70	Award for synthetic zeolite adsorb- ents (N) Oct. 2 Zeta potential—New tool for water treat- ment. T. M. Riddlek (charts) Pt 1 June 26 *121, Pt 2 July 10 *1	
Trailer vans—new housing for CDI	76	posal costs (N)	100	Zinc	41
control operations (N)Aug. 21 Tubing—Copper-nickel alloy permits	*64	"Junkman" firm cuts local CPI disposal costs (N)	*70	Hot-dip zinc coatings for galvanized products—manual offered May 15	98
cheaper tubes for feedwater heaters	*114	ends paper mill's disposal woes (N) (table)	*90	Magnesium added to galvanizing zinc	26
high-temperature uses Dec. 11	182			Zincating bathJune 12 17 Zone Refining—Purifying solids tech-	12
Tungsten disulfide goes commercial Nov. 13		effluent permits re-use (chart) (N) Nov. 13	110	Improves corrosion resistance. Oct. 10 Zincating bath	47
	NOTI	ES-*Illustrated; (N) News; (P.N.) Plant	Noteb		

AUTHOR INDEX

Alman C P A P W P	
Alves, G. E. & E. W. Brugmann	
Estimate viscosities by comparison	
with known materials Sept. 18	*181
Arndt, Fred W.	
Plastic scrubbers control air pollution	
Nov. 27	4440
	-140
Arnold, T. H., Jr.	
First petrochemical step a big one	
Sept. 4	*106
Lean gases yield chemical feedstocks	
July 24	*112

	New	catalyst	for	butadiene	unit Oct.	30	*90
				lean-gas	venture Aug		*104
A	Graph		aetho	d conver			*200
A		S. M. & ess in			science	11	142

Avati, Helen New route to isopreneMay 29	•42
Barnes, B. E. Magnesium producer shuns electrolysis May 29	*70
Barth-Wehrenalp, G. Inorganic-polymer chemistry way to high-temperature plastics Oct. 30	*117

uric 29 48 elds 20 *118

23 *78 life trol s. 7 *66 per trol s. 7 *70 ste-20 96 na-25 38 fer ing ... 2 60

ds 23 *96 ls. 20 *170 ng 20 *192 1 *52 sl- 9 *132 e- g- 6 *76

29 48 at 18 *82

k 2 *46 -0 *141

d 5 198 c 6 *226 2 112 c 3 *147

*42

*117

Inc	lex to voi. oo, January to December	AVII
Bashar, Mohammad	Cooper, F. P. & others Vibrating screw pushes solids into	Harel, S. Filter prevents blackened lead welds
Charts and tables speed up thermowell specifications	vacuum reactor systemOct. 2 •124 Coopey, Walter	Harriott, Peter
Hydraulic presses		Designing temperature-stable reactors
Baukol, Philip J. Plant designers need suppliers' help in solving equipment puzzles. Sept. 18 *171	Water-spray keeps compressors clean	Pt 1 May 15 *165, Pt 2 May 29 *81 Haselbarth, J. E. & J. M. Berk Cost-capacity data. Pt. II Jan. 23 161 Pt III Feb. 20 *174, Pt IV Mar. 20 *182
Bean, C. F. Tags and magnet date stored material	Professionalism is a two-mile road	Havighorst, C. R.
Beckner, Jack L. Mar. 20 *174	Curran, E. C. June 26 *136	Beet sugar: a radical new lookOct. 2 *76 Winery keeps age-old process current
Use these one-step equations to find reboiler and condenser duty. Feb. 20 *164	Use liquid solder to attach backing screens	Hendel, Frank J. Feb. 6 *76
Benson, Bernard "Engineermanship" Aug. 21 *134 Berk, J. M. & J. E. Haselbarth	Process controlJune 12 *187 Dahler, John S.	Rocket Propulsion Chemical rocket-propulsion systems Mar. 6 *99
Cost-capacity data Pt. II Jan. 23 161 Pt. III Feb. 20 *174, Pt. IV Mar. 20 *182	Powerful tool: statistical mechanics Jan. 9 *111	Advanced rocket propulsionApr. 3 *131 Exotic rocket-propulsion systems
Bernd, S. M. Some myths of professional practice	Vibrating screw pushes solids into	Hendrix, Charles D. July 24 *135
Bertrand, Louis & J. B. Jones Controlling distillation columns. Feb. 20 *139	Vacuum reactor systemOct. 2 *124 Dickens, W. A.	How many batches should you plan? Dec. 11 153
Bird, Owen	Solvents calibrate explosives meter Jan. 23 157	Hertan, William A. Is your eye on the executive suite?
Automatic steam siphon revisited Nov. 27 *138 Block, Benjamin	Diss, E. M. & others Practical way to size safety disks Sept. 18 *187	Hetrick, James C. Operations research: a progress report
Batch distillation of binary mixtures provides versatile process operations	Doolin, John H.	Holmes, John Jan. 23 137
Bonsall, R. A. Feb. 6 *87	Centrifugal pump lubrication . Oct. 16 *210 Dowding, C. W. & F. R. Russell Process evaluation in computer-run	Versatile scrub tower removes halogen off-gases
Chart gives solubility of SO ₂ in ammonium bisulfite	Drinker, P. H. & others	Graphical prediction of ternary azeo-
Bott, Robert P. Make management training count June 26 *146	Progress in plant measurements June 12 *199 Driskell, L. R.	tropesMar. 20 *159 Hougen, Joel O. Process dynamics by pulse testing
Boucher, R. M. G. Ultrasonics in processingOct. 2 *83	Steam distribution: better control at lower cost	Howe, W. H. & others
Bowen, Richard L., Jr. Scaleup for non-Newtonian fluid flow	Edwards, V. H. & R. A. Conway How to design sedimentation systems	Progress in plant measurements June 12 *199
Bowen, Richard L. Jr. Scaleup for non-Newtonian fluid flow June 12-243, June 26-127, July 10 147 July 24-143, Aug. 7-129, Aug. 21 119	from laboratory dataSept. 18 167 Epstein, Norman	Hower, N. R. Liquefied gases: cryogenic or pressure
Proup Edward M	Apply fluidization to gas humidification Dec. 25 81	storage?
Physical properties of allyl alcohol summarized	Ermenc, Eugene D. Designing a fluidized adsorber. May 29 *87 Fahnoe, Frederick	fluctuations
What it takes to get that new job Feb. 20 *158	Thermistor interface controlJan. 23 159 Feng, Paul Y.	New process for Ti-clad steel plate May 15 *194
Brown, Bradford S. Quick ways statistics can help you	Is radiation chemistry practical? Dec. 25 67	Where standards standNov. 13 *201 Jacks, Robert L.
Brown, W. G. & C. M. Loucks	Forbath, T. P. Chlorite plant casts Kesting process in	Sound suppression in the chemical process industriesFeb. 20 *127
Reactor vessels cleaned with nitric "vapor"	its original roleJune 12 *180 Process maze yields maize products Mar. 6 *90	Jackson, Thomas M., Jr. Filter aids speed up "difficult" filtra- tions
Brugmann, E. W. & G. E. Alves Estimate viscosities by comparison with known materialsSept. 18 *181	Solids-gas reaction slashes borohy-	Jahreis, Carl Design pump air chambers to control
Bullock, H. Leslie Progress in electrostatic separations	Ford, R. W. & K. D. Kiss Eliminate contamination of Ziegler-	pressure pulsation Sept. 4 *150 Johnson, A. N. & others
Burkhardt, Donald B. Oct. 2 *101	catalyst componentsAug. 7 *148 Franks, F. C.	Vibrating screw pushes solids into vacuum reactor systemOct. 2 *124
Kinetic plots aid catalytic operations June 26 *115 Burnet, George & J. C. Clifford	Double rupture disks cope with severe conditions	Johnson, K. J. Two ideas combine for versatile tank installation
Use of flanged joints in liquid-metal	Evaluate heat exchanger coefficients Mar. 20 •151	Johnson, R. J. Device takes samples during lab
Campbell, K. K. & P. S. Kingsley Teflon liner repairs corroded pipe	Frederick, Edward R.	Johnson, Roger T.
Cannon, Michael R.	relectrostatics June 26 *107 Freshwater D. C. & T. K. Ross Tabulated flowsheet data Apr. 17 *177 Friedman, S. H. & J. W. Murtha	Semiquantitative test checks for impurities
Some common errors in thermody- namics	Friedman, S. H. & J. W. Murtha Estimating air-cooled exchangers made	New solid-state-chemistry methods yield ultrapure materialsJan. 23 *147
Nomograph converts dew point to water content of gasSept. 4 *154	easy	Jones, Cliff Practical way to size safety disks
Nomograph gives density of moist or dry airOct. 39 136 Caras, G. J.	Fulks, Bernard D.	Jones, H. M., Jr. Sept. 18 *187
Simple method proves multiplication	Automatic device maintains liquid nitrogen levelOct. 30 *132	Shortcuts in distillation design. Aug. 7 *125 Jones, J. B. & Louis Bertrand
Carroll, Charles E.	Gibbons, Edward J. Design charts. Aug. 7-154, Sept 4-156.	Controlling distillation columns. Feb. 20 *139 Jones, Sam A. Spiral brush con food or screen dry
Increase your plant profitability by decreasing capital costNov. 27 *113 Chandler, Harold J.	Oct. 2-126, Oct. 30-138, Nov. 27 134 Dec. 25 98 Design a Venturi feeder for dry bulk	Spiral brush can feed or screen dry material
Control maintenance by work measure- ment	materialsJuly 10 *158 Goldman, Thomas M.	Practical way to size safety disks Sept. 18 *187
Empirical equation for non-Newtonian	Falling-film exchanger adapts to acid dilution	Katz, J. J. & Irving Sheft Non-aqueous solvent systems. Nov. 13 *223
systems	Is your "trade secret" really a trade	Kendall, H. B. Nomograph gives reaction time or reactor size
radiation hazards	secret?	Kiachif, M. F. Try ceramics for resistance to cor-
Use of flanged joints in liquid-metal service	Gregor, Harry P. June 12 *199	rosion, erosion
Cling, Jackson Charts give vessel weightJune 12 *258 Coates, Jesse & B. S. Pressburg	Ion-exchange resins and membranes Dec. 25 •73	Chemical kinetics—expanding field Oct. 30 *111
CE Refresher: Review principles of distillation	Gries, W. H. Simple device for continuous CO ₂ indi-	Kingsley, P. S. & K. K. Campbell Teflon liner repairs corroded pipe Aug. 7 *156
Analyze material and heat balances for continuous distillationFeb. 20 *145	cation	Kirknatrick Sidney D
How to analyze the calculations for batch rectification in tray columns	A survey of the new chemistry. Jan. 23 *144	Upgrading nature
How to make distillation calcula-	Hackney, John W. Construction schedules improve work	catalyst componentsAug. 7 *148 Klima, B. B.
Predicting tray efficiency in distil-	Apr. 3 *155 Estimate production costs quickly	Lead ring gives tight seal in packed columns
CE Refresher: Simultaneous transfer	How to appraise capital investments	Are canned pumps for you?May 1 *95 Kouzel, Bernard
of heat and mass. Pt 1 May 29 *95 Pt 2 June 26-131, Pt 3 July 24 151	May 15 145 Haensel, Vladimir	Manifold sizing and pipe scaleup done graphicallyJuly 10 *160
Conway, R. A. & V. H. Edwards How to design sedimentation systems	Catalysis	Kulick, William You can read faster—and learn more
from laboratory dataSept. 18 167 Cook, E. M.	steel tanks for rocket fuelsDec. 25 108	Nov. 13 *240 Kuong, J. F.
Eliminate dust from piston effect Apr. 17 *196	Explosion suppression: new safety tool Dec. 25 85	Nomograph gives diffusion rate in dilute solutionsJune 12 258

ΜI

Index to Vol. 68, January to December 1961

FOF

MO

INF

• Adve

• New

• Man

• Class

Also .
• Repr
• Subs

Your R

USE EITI CAF

They're to fold

tear or

Labine, Roland A. Petrochemicals: what's aheadSept. 4 *113	Nicklaus, G. E. Steadier course for naphthalene	Schossberger, F. V. Solid-state chemistry gives insight into
Lammers, G. C. Unitized investments for quick unit costs	Jan. 23 82 Oliu, Ramon Estimate water of saturation. Mar. 20 *174	crystal behavior
Graphical method finds logarithmic	Othmer, Donald F. Japanese chemicals boomFeb. 6 *54	Scott, Richard W. Sept. 18 *175
mean valuesJune 12 *254 Lee, Chesman A. Are you getting the most out of	Overman, R. T. & F. A. Rohrman Radioisotopes help solve CPI engi- neering problems	Electrical safety guide to hazardous process areasJuly 10 *123 Shea, George F.
closed-circuit grinding? May 29 *112 Lemlich, Robert	Parekh, Kishor H. Cleaning exhaust line may solve	Solenoid valves simplify automatic gas sampling
Test your CEQ. Jan. 23-159, Feb. 20 168 Mar. 20-178, Apr. 17-198, May 15 184 June 12-256, July 10-160, Aug. 7 148	vacuum problemJune 12 260 Peck, A. R. Analysis of fluid-system dynamics	Non-aqueous solvent systems Nov. 13 *223
June 12-256, July 10-160, Aug. 7 148 Sept. 4-152, Oct. 2-124, Oct. 30 134 Nov. 27 136	Peters, J. Irwin	Sheldon, E. K. Inside view of a modern, complete alum plant
Use this simple organic chemistry shorthand	Humanities: dust them off, don't knock them downOct. 2 *116	Shulman, William A. C. electric motors Oct. 30 146 Physical properties of ethanol in rapid
Vibration and pulsation boost heat transfer	Peters, Robert L. Determining equilibrium in combustion chambers	roundup
Emergency filter-cloth support made of wood	Pierce, M. K. Automatic steam siphon revisited	Safe siphoning of hazardous liquids Apr. 17 *200
Lerman, Frank Table calculates change of concentration vs. time	Nov. 27 *138 Thermostatic trap makes automatic steam siphon	Signorini, Dr. Ing. Giuliano Find optimum frequency of inspection Mar. 6 *138
Lipinski, Frank Calculate pressure drop for flowing	Plant, George W. Control by special-purpose analogs	Silverman, Leslie Double polyethylene drums for simple
gases from tablesJuly 10 164 Liptak, Bela G.	Pohl, Herbert A. The organic semiconductor challenge	calibration tank Aug. 7 *150 Smoot, L. Douglas Transport phenomena—CF Refresher
Process instrumentation elements Control and relief valvesAug. 7 137 Process-control instrumentsNov. 27 140	Oct. 30 104	Transport phenomena—CE Refresher Aug. 21 126, Sept. 18 183, Oct. 16 187, Nov. 27 119
Process-vessel protectorsDec. 25 104 Litwak, Alfred	Popper, Herbert The CPI looks at equipment leasing Aug. 21 *136	On increasing accuracy of planimeter
Chemical spending advances cautiously May 15 74 Chemical spending: clipped but	Postma, A. K. Cut-out slide rule solves Stoke's law calculations Nov. 27 *136	measurements Dec. 25 98 Stanbury, W. A., Jr. & Lynn Surles How to improve the meetings you run
still growingJan. 9 48 Loucks, Charles M.	calculations	Stevenson, Alan
A chemistry professor tries his hand at plant maintenance	distillation Analyze material and heat balances for continuous distillationFeb. 20 *145	Nomograph finds available net positive suction head
plant maintenance	How to analyze the calculations for batch rectification in tray columns	The men in the middleFeb. 6 *112
New nuclear plant to have radiation	Jan. 23 *131 How to make distillation calculations Mar. 20 *155	Superphosphoric acid paves way for fertilizer shift
available for processingAug. 21 *107 Luke, Yudell L. Numerical solution of the heat con-	Predicting tray efficiency in distil-	How to improve the meetings you run Mar. 6 *128
duction equationJan. 9 *95 Macanka, A. A.	CE Refresher: Simultaneous transfer of heat and mass. Pt. 1 May 29 *95	Surowiec, A. J. How to figure transfer units from
Polyethylene bottle makes emergency lab scoop	CE Refresher: Simultaneous transfer of heat and mass. Pt. 1 May 29 151 Raddle, H. & G. MacBeth Easy-to-build metering pump Corres	theoretical platesJuly 10 *139 Symons, E. F. Fluorescent tube illuminates turbidity
Easy-to-build metering pump carries corrosives Oct. 2 *122 Machwart, G. M.	Ramberg, E. M.	Thompson, David H. Sept. 4 *150
Machwart, G. M. Film coefficients for glass-lined re-	Corrosion-resistant hose: where does Teflon fit in?Feb. 20 *180 Richardson, D. R.	How to prevent stress-corrosion crack- ing of copper alloysFeb. 6 *130 Threlkeld, D. & J. E. Troyan
actors	How to design fluid-flow distributors May 1 *88	operations
Maddox, R. M. Aug. 21 *128	Richardson, Wingate H. Are your department's costs meaning-ful?	Elements of operating manuals
Calculations for multicomponent dis- tillation	Coexistence for design and operating engineers?	Pt. II Troubleshooting new equip-
Evaluating quantity discountsMar. 6 *117 Margrave, John L.	Manufacturing: is it art or science? Jan. 9 *124 Riddick, Thomas M.	Pt. III More on troubleshooting
High-temperature and plasma chemistryOct. 16 *168 Mark, H. F. & S. M. Atlas	Zeta potential: new tool for water treatment Pt. 1 June 26 *121, Pt. 2	new equipment
Progress in high-polymer science Dec. 11 143	Robbins, M. D. July 10 *141	Tykodi, Ralph J.
Martell, Arthur E. New data on metal-complex formation Nov. 27 *95	Pulp plant wrings profit from lignin June 26 *100 Rodriguez, Ferdinand	Irreversible thermodynamicsNov. 13 *238 Underwood. W. Murray Tables speed viscosity conversion
Mason, W. A. Graphical method for showing four	Theoretical plates with no equilibrium plot	Webster, Robert M. Aug. 21 117
Mayhew, W. Charles		Reinforced plastics for corrosive service Pt. 1 June 26 *154, Pt. 2 July 10 *168 Wentorf, Robert H., Jr.
CS charts find further applications June 26 *142 McEachron William D.	Randisotopes help solve CPI engineering problems	High-pressure chemistryOct. 16 *177 Whitley, Donald L. Numerical mathematics for chemical
Role of P. I. in investment evaluation June 12 *239	Rubin, Frank L. Testing for leaks in heat exchangers July 24 *160	Numerical mathematics for chemical engineers
McGovney, G. F. & W. I. McKay The pro and con of multiple-contract construction	Rudkin, John Equation predicts vapor pressures	Make your own tool for tapping pressurized linesSept. 4 *156
McKay, W. I. & G. F. McGovney The pro and con of multiple-contract	Apr. 17 202 Ruiter, J. L. & A. H. Younger	Mathematics of controlJan. 9 *103
construction	Selecting pumps and compressors June 26 *117	Systems engineering Pt. 12 Feb. 6 *107, Pt. 13 Apr. 3 *149, Pt. 14 May 1 *87 Wilson, N. E.
Analog solves partial differentials Mar. 6 *121 McKinney, Alfred H.	Russell, F. R. & C. W. Dowding Process evaluation in computer-run	Zinc dust improves polyethylene coatings
Control solids-drying equipment. May 1 *79 Mendel, Otto	microplantOct. 30 *97 Schall, William C.	Wroth, William F.
Process—piping materialsMay 15 190 Moore, Robert W. Change filter base quickly July 10 160	Dollar thinking in process control June 12 *189	Packed-tower costsJuly 10 166 Younger, A. H. & J. L. Ruiter
Change filter bags quicklyJuly 16 166 Murtha, J. W. & S. H. Friedman Estimating air-cooled exchangers	What are the dynamic objectives? Mar. 20 166	Selecting pumps and compressors June 26 *117
made easy	Schall, W. C. & Steven Danatos Process controlJune 12 *187	Zabel, L. W. & S. W. McKibbins Analog solves partial differentials Mar. 6 *121
Estimate high-vacuum costs graphi-	lems in centrifugal compressors	Ziegfeld, Robert L. How to choose lead linings for process
callyOct. 2 *107	Nov. 13 *254	vesselsJan. 23 *164

FOR MORE INFORMATION

Advertised
 Products

0 3 •213

y 8 *175

8 0 *123

8 7 *132

2 *223

e 0 *132

0 140

1 5 *186

s 7 *200

*138

*150

119

*128

*112

*160

*128

*139

*150

*130

164

*134

147

91

164 233

117

168 177 101

262

166

21

64

- New Equipment
- New Chemicals
- Manufacturers'
 Literature
- Classified
 Advertisements

Also . . .

- Reprint orders
- Subscriptions

Your Reader Service cord is fastest.

USE EITHER CARD

They're easy to fold and tear out . . . try it . . . PLEASE PRINT *
NAME:
TITLE:
COMPANY:
NO. OF EMPLOYEES:
PRODUCT:
ADDRESS:
CITY, STATE:

FIRST CLASS PERMIT NO. 64

(Sec. 34.9 P.L.&R.) NEW YORK, N. Y.

BUSINESS REPLY MAIL

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

-POSTAGE WILL BE PAID BY-

Chemical Engineering
READER SERVICE DEPARTMENT
330 West 42nd St.
NEW YORK 36, N. Y.

PLEASE PRINT *

TITLE:

COMPANY:

NO. OF EMPLOYEES:

PRODUCT:

ADDRESS:

FIRST CLASS PERMIT NO. 64

> (Sec. 34.9 P.L.&R.) NEW YORK, N. Y.

BUSINESS REPLY MAIL

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

-POSTAGE WILL BE PAID BY-

Chemical Engineering
READER SERVICE DEPARTMENT
330 West 42nd St.
NEW YORK 36, N. Y.

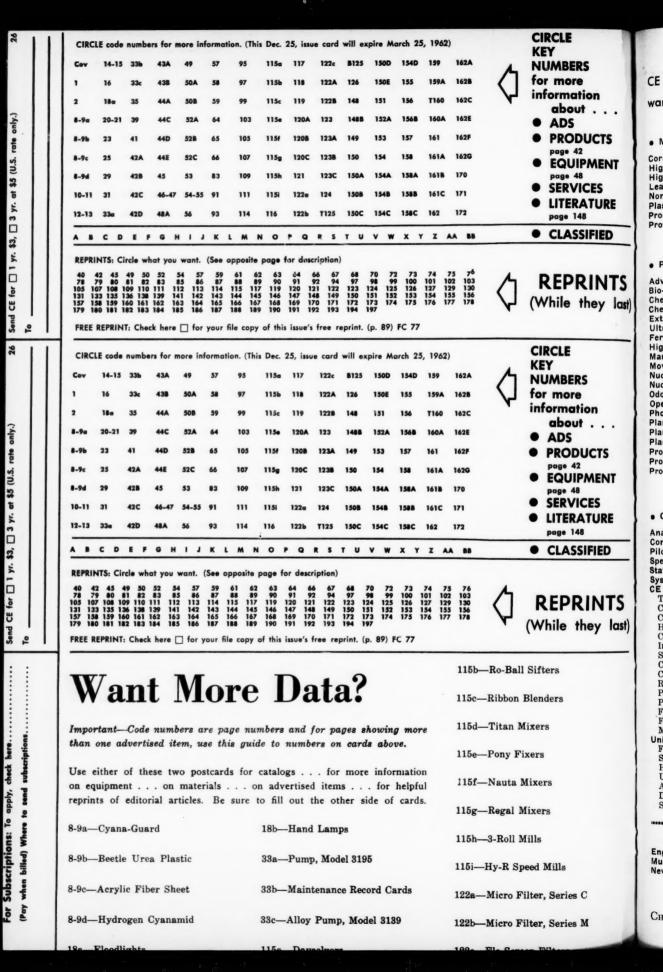


Help Yourself . . .

The postcards above can now bring you technical help, latest literature, expert guidance. Tear one out and, as you read this issue, circle numbers when you want more information. You'll note that the coding system is simple: all the code numbers are page numbers.

You can also use these post-paid cards to subscribe, or to make your selection from a comprehensive list of editorial reprints.

* Be sure to fill in all of these address blanks before mailing postcard.



МΙ

CE editorial reprints are now easy to get—use Reader Service Card for fast service.* For each reprint you want just circle its number on the card. Fill in the blanks on the front, mail. Send remittance if you wish.

For a new reprinting of Chemical Engineering's cost estimating articles; see p. 162 . MATERIALS OF CONSTRUCTION . EQUIPMENT AND DESIGN Corrosion-Refresher on cause & cure (\$1)...........131 Air Pollution—CPI plant solutions (50¢)......143 High-Temperature Materials—Inorganic, nonmetals (75ϕ) . 120 High-Temperature Metals—Selection, directory (\$1)....129 Lead Installations—Best designs for many uses (50ϕ) ... 79 Nonmetallic Inorganics—For severe conditions (50ϕ) ...125 Plastic Pipe—How and when to use (75ϕ)135 Process Piping Materials—Selection directory (\$1).....169 Estimating Engineering Properties Thermal Cond. (50ϕ) ...94 Viscosity (75ϕ)138 Heat Capacities (75ϕ) .109 Critical Properties (75ϕ) .149 Latent Heat (75ϕ) ...117 Other Physical Properties (50ϕ)151 Protective Linings—Choice, application, directory (\$1).. 88 Surface Tension (75ϕ) .126 (50ϕ) .151 Flow Sheets—Engineering communiques (50ϕ) .99 Flow Through Packing and Beds PROCESSES Packed Towers (50¢)......103 Advanced Chemical Rocket Propulsion Systems (50¢)...179 Fermentation—Its chemical technology (50¢)..... High-Temperature Technology—Materials, uses (50¢)...91 Manufactured Gas—To supplement natural gas (50¢)...115 Piping-Roundup of process pipe, valves, fittings (75¢).. 40 Moving Bed Processes—Theory plus application (75¢).. 64 Pump Seals—Chemical plant practice (50ϕ) ... 92 Water Conservation—Will taps run dry? (50ϕ) ... 105 Odor Control-How to be a good neighbor (50¢).. Water Pollution-Solve plant problems (50¢)......122 Your Design Reference File 100 Parts I-V (75¢) 110 Parts VIX (75¢) 110 Operation & Maintenance—The impact of trends (\$1)...121 . COSTS AND COMMERCE Processes & Technology—9th Inventory, 1959 (50¢)...159 Processes & Technology—10th Inventory, 1960 (50¢)...171 Processes & Technology—11th Inventory, 1961 (50¢)...184 Buyer-Seller Relations-Vendor's view (50¢)..... Capital Cost Estimating—Data, sources & methods (\$1).156 Capital Investments—Appraisal methods (50¢).....182 CE Cost File, 1959—Quick estimating data (50ϕ)153 CE Cost File, 1960—Quick estimating data (\$1).......172 Cost Control Systems—Reduce and control costs (50ϕ) .102 CPI Forecast for '61 (50ϕ)170 . CHEMICAL ENGINEERING SCIENCE Inflation—How to predict a shrinking dollar (50¢)..... Analog & Digital Computers-In engineering use (50¢)..145 Operator Shift Schedules-How to organize (50¢).....175 Conference on the New Chemical Engineering (\$1.50)..173 Patent Fundamentals—Timely review (50¢)......114 Pilot Plant—All the aspects of scale up (\$1)......127 Speculative Process Design—Pilot plant bypass (50¢)..146 Petrochemicals—What's ahead (50¢) 189 Process Energy—Make or buy? (50¢) 142 Professional Registration-For PE-minded ChE's (50¢). 35 CE Refresher Rockets and Missiles—Airborne reactor problems (75¢).119 Thermodynamic Principles (50ϕ) 42 Compression & Expansion (50ϕ) 45 Chemical Equilibrium (50ϕ) 57 Catalytic Kinetics (50ϕ) 66 Simple Reactor Design (50ϕ) 75 Catalytic Reactor Design (50ϕ) 75 Catalytic Reactor Design (50ϕ) 75 Chaptic Reactor Design (50ϕ) 75 Catalytic Reactor Design (50ϕ) 75 Catalytic Reactor Design (50ϕ) 81 Reactor Design (50ϕ) 87 Physical Equilibrium I (50ϕ) 90 Physical Equilibrium II (50ϕ) 97 Fluid Flow Equations (50ϕ) 101 60's Challenge Chemical Engineers (50ϕ)152 UNIT OPERATIONS Absorption With Chemical Reaction (50ϕ)162 Batch Distillation of Binary Mixtures (50¢)......174 Binary Distillation—Theory, equipment (75¢)..... Compressible Fluids-How to handle (\$1)..... Crystallization—For purification (50¢)......124 Plant Startups—Systematic preparation (50¢).........165 Solids Concentration—Survey of techniques (50¢)..... 67 Solids-Gas Contacting—Commercial practice $(50 \, \rlap/e)$ 63 Solids—Liquid Separation—Operations, descriptions (\$1) 62 Absorption Methods (50¢)......168 Solid-Solid Blending-Theory, practice, equipment (75¢).163

RECENT REPRINTS-TO KEEP YOUR FILES UP-TO-DATE

Engineering Standards—At home and abroad (50¢)192	Plants & Facilities-13th Inventory, 1961 (50¢)191
Multicomponent Distillation (50¢)194	Transport Phenomenon-Refresher (50¢)193
New Trends in Chemistry (\$2)197	Ultrasonics in Processing—Uses and trends (50¢)190

^{*}Don't forget to check the Free Reprint box for your extra copy of this issue's reprint feature (p. 89)

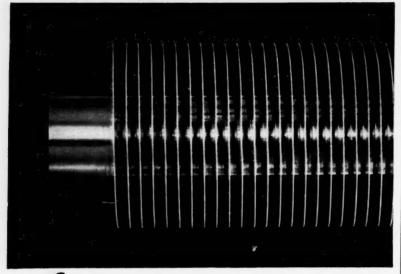
JRE

ED

v last)

RE

ast



AEROFIN Smooth-Fin Coils offer you

Greater Heat Transfer per sq. ft. of face area

Lower Airway Resistance

—less power per c.f.m.

Aerofin smooth fins can be spaced as closely as 14 per inch with low air friction. Consequently, the heat-exchange capacity per square foot of face area is extremely high, and the use of high air velocities entirely practical. Tapered fin construction provides

ample tube-contact surface so that the entire fin becomes effective transfer surface. Standardized encased units arranged for simple, quick, economical installation.



AEROFIN Corporation

101 Greenway Ave., Syracuse 3, N. Y.

Write for Bulletin S-55

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

Manufacturers' Literatu

Contents of This Issue

Chemicals	148
Construction materials	152
Electrical & mechanical.	152
Handling & packaging	154
Heating & cooling	154
Instruments & Controls	156
Pipe, fitting, valves	158
Process Equipment	159
Pumps, fans, compressors	161
Services & miscellaneous	162

Chemicals

Acrylic	Monomer	s	New,	revised
	tin gives			
	on stora			
	lic monor		rite t	o Dept.
SP-3	31 for you	r copy.		
121		*R	ohm	& Haas

Activated	Carbo	n	A c	omplet	e line
	ivated				
	design				
	purifi				
recove	ery sys				
170			*Barn	ebv-Cl	nenev

Activated	Carbon		An ill	ustrated
brochu	ire co	ntains	basic	design
	ques f			
	phase,		nuous	column
adsorp	tion sy	stems.		
49	*Pit	tsburgh	1 Chen	nical Co.

Ammonium Sulfate B & A ammonium sulfate is purified and is a primary product of selected raw materials not a by-product. For processing foods & pharmaceuticals.

25 *Allied Chem., Gen. Chem. Div.

Catalog.....75-page catalog lists and describes industrial chemicals for international sale and also provides information on packaging and application. 148A Diamond Alkali Co.

Fu	ırfuryl	Alcoh	ol	ha	s a	marke
	effect	on th	e pro	perties	of	urea-for
	mald	ehyde,	pher	iol-for	male	dehyde d
	epoxy	resir	is. I	Details	on	furfur
		ol in	Bul.	205.		
	37			*Qual	rer	Oats Co

lo

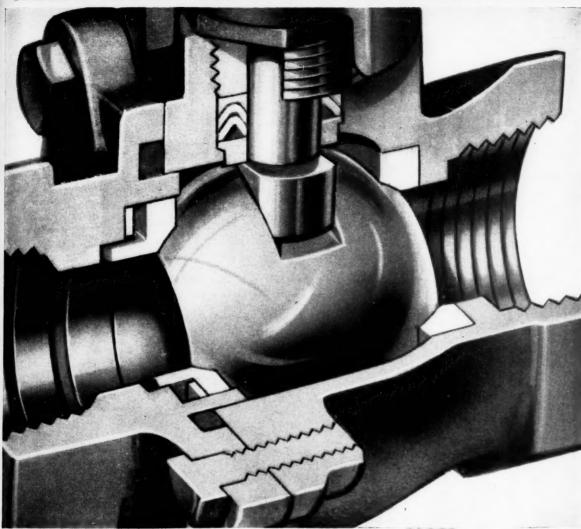
C

Hydrogen	CyanamideTh	e cyan
amide	radical is now ava	ilable a
a sta	ble, colorless, cond	entrate
	queous solution of	hydrogen
8-9d	mide. Information. *American Cyan	amid Co

Meta-phenyl	lenediamii	ne	43-pag
bulletin	I-23 de	scribes	chemica
used as	a curing	agent	for epox
resins a	nd as an	interr	nediate i
dye syn	thesis.		
148B	Natio	onal A	niline Di

^{*} From advertisement, this issue

TAKE A CLOSE LOOK AT ROCKWOOD BALL VALVES



How important is "choice"?

eratu

revised informaidling of to Dept.

& Haas

olete line
ery purate comation &
22.

-Cheney
lustrated
design
and column
nical Co.

A ammonical is a
ted raw
tet. For

naceuti-

em. Div.

ists and cals for

provides and ap-

kali Co.

marked

rea-forehyde &

furfuryl

Dats Co.

e cyanlable as entrated ydrogen

mid Co.

43-page hemical r epoxy diate in ine Div.

ING

Few valve installations have identical characteristics. That's why you should look into the wide choice available in Rockwood Ball Valves. Rockwood Valves offer all these characteristics in various combinations: Castings of stainless and carbon steel, or bronze... flanged, sweat or screw ends...

rubber, Teflon, nylon or Kel-F ball seats . . . lever, gear, air, electric or hydraulic operation . . . pipe sizes from \(\frac{1}{6} \)" to 14".

When you call in a Rockwood man, you're sure to get the valve you need — not just the valve he has to sell.

And Rockwood Ball Valves have these important advantages:

Larger waterway diameters for smoother flow.

Ease of maintenance — no lubrication is needed; most parts replaceable with ordinary tools. **Spring-loaded ball seats** for longer, tighter sealing.

Reliability — backed by the timeproven experience of the pioneer in modern ball valve design.

Your Rockwood man can provide full details, or write Rockwood Sprinkler Company, Ball Valve Department, 278 Harlow Street, Worcester 5, Mass. Distributors in all principal industrial areas. Rockwood Sprinkler Company, A Division of The Gamewell

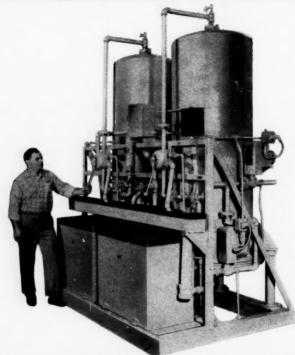
Company, A Subsidiary of E.W. Bliss Company.



ROCKWOOD

BALL VALVES

BARNSTEAD TWO-BED DEMINERALIZERS



EASY TO OPERATE—EASY TO REGENERATE BUILT TO LAST 30 YEARS

Barnstead engineers designed these Two-Column demineralizers in capacities of from 30 to 3000 gallons per hour. Shown here: Model TM-6 which produces 2000 gallons per hour. You can select from seven different models the unit best suited to your needs. Barnstead Demineralizers come ready to work . . . units are mounted on heavy steel frame with skid base . . . all piping and valves are in place with resins in columns . . . ready to produce pure demineralized water. Regeneration is easy . . . foolproof . . .

What are often "extras" in other equipment is part of the complete package with Barnstead. Features include: Water-pressure gauge, flow meter, multiport valves, eductors, built-in regenerant tanks, all interconnecting piping completely assembled, purity controller with red and green lights to show when water is up to purity standards and when demineralizer should be regenerated. Rugged construction . . . built to last 30 years.

with no special operative skill needed.

FOR COMPLETE INFORMATION

Write for Catalog #160. Describes complete Barnstead line of Mixed-Bed, Two-Bed and Four-Bed Demineralizers.

Barnstead STILL AND STERILIZER CO.

4 Lanesville Terrace, Boston 31, Mass.

LITERATURE . . .

Methylpyrrolidone...... A stable lactam featuring high solvent capacity, maximum safety, and miscibility with organic solvents and water is described in bulletin.

150A Antara Chemicals

Plastic......A new brochure giving complete technical data on Kel-F 81 plastic is available. Contains complete laboratory and test data on chemical and physical properties.

126 *Minn, Mining & Mfg. Co.

Products......Catalog lists lithium chemicals, metal and minerals, welding grade products etc. for application in chemical, metallurgical etc. industries.

150B Foote Mineral Co.

Sodium Isethionate.....10-page bulletin AP-103 describes properties and uses of difunctional chemical intermediate used in the manufacture of many compounds. 150C Antara Chemicals

Styrene Monomers.....16-page bulletin 170-133 discusses styrene, vinyltoulene, divinylbenzene and alphamethyl-styrene monomers and includes numerous graphs and charts. 150D The Dow Chemical Co.

Tar Bases......6-page booklet treats in chart form the specifications and properties of selected tar bases including quinaldine, pryidines, quinoline etc. 150E Allied Chemical Corp.

Textile Chemical.....Cyana-Guard is now used in the dry cleaning process to restore moisture to clothes and to prevent perspiration odor from developing. Information. 8-9a *American Cyanamid Co.

Thinners.....Tolu-Sol thinners allow you to choose the precise solvency you need. Information is contained in Technical Bulletin SP-61-2 which is available. 46-47 *Shell Oil Company

Urea Plastic.....Beetle urea plastic is corrosion-proof and has good heat resistance and does not build up dust-attracting static charges. Further information. 8-9b *American Cyanamid Co.

sp

is

Want to build up your files and keep them up-to-date? You can get any publication in this comprehensive guide — free — just for the asking.

It's easy — simply circle item's number on the Reader Service Postcard and mail. Replies will come directly from companies offering the literature.

МΙ

New Westinghouse digital draw-speed indicator instantly reports precise strip process speeds and speed differentials



Immediate knowledge of speed differentials, surface speeds, section speeds, speed ratios, improper slack, and drift is vital to improved product quality, uniformity, and output in the strip process industries.

The new Westinghouse digital draw-speed indicator has been designed to meet your accurate process speed requirements. This digital instrument measures surface speeds,

speed difference between sections, and speed ratios between sections with accuracies of .1 foot per minute or 1 foot per minute. The completely transistorized digital indicator is entirely free from drift and retains its initial accuracy indefinitely.

This versatile product continually monitors speeds and draws, allowing fast location and trouble shooting of the causes of machine variations. In addition, it isolates the source of trouble to either regulator or mechanical problems.

It provides information that eliminates trial-and-error machine set-up. It permits the operator to accurately set up the ideal speed or draw on any given machine section, based on recorded data from previous runs.

Already proven in the paper and plastics industries, this new development is well suited to other strip process industries such as aluminum, steel, textile and rubber.

For more information, contact your Westinghouse representative or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. You can be sure . . . if it's Westinghouse.

J-40540

able lac-

nt capacd miscients and

etin. hemicals e giving on Kel-F

Contains est data proper-

Mfg. Co.
lithium
minerals,
etc. for
netallurderal Co.
ge bulleties and
ical inanufacmemicals

alphaand as and ical Co.

cations r bases yidines, l Corp. uard is g procclothes n odor on.

lvency tained P-61-2 mpany

stic is d heat ild up . Fur-

id Co.

our

-to-

ıbli-

sive

the

cle

der

ail.

tly

the

NG

Westinghouse





seamless reinforced plastic tanks

up to 11½ feet in diameter

The largest reinforced plastic tanks obtainable using seamless, panelless sidewall construction.

Now available in shell sizes of standard capacity increments, the new mandrel-formed tanks can be fabricated in standard diameters of up to 111/2 feet ... in lengths up to 12 feet. Homogeneous tank walls are truly cylindrical and of uniform thickness ... offer complete corrosion resistance inside and out. Tanks...even the largest sizes...are self-supporting. They require no external steel or guying...no painting or maintenance of any kind. Special models can be furnished for pressure or vacuum service.

This new construction, now available in a wide variety of resin formulations, offers complete corrosion control over a broad spectrum of chemical process conditions. Standard hangers, nozzles, and manhole covers in a variety of sizes can be furnished to specification. Flat or dished heads are optional.

For complete information on how du Verre seamless RP tanks can provide lowest cost, corrosion-free service in process and storage applications, request Catalog No. 110.



First in Quality for Complete Corrosion Control with Reinforced Plastics

> Box 37A Arcade New York

 Atlantic Beach, Florida Plants in Arcade. New York

LITERATURE . . .

Construction Materials

Acrylic Fiber Sheetis resistant to common solvents, most chemicals and ultraviolet light. This material and ultraviolet light. This material is adaptable to a wide variety of uses. Information.

8-9e *American Cyanamid Co.

.Dimecote coating resists Coating. weathering, salt spray, petroleum products and severe abrasion for long periods of time. Technical long periods of time.
data are available.
*Amercoat Corp.

rication.....Plate work of all kinds and sizes. Equipped with modern fabricating facilities & strategically located for rail, truck or water shipment. 11 *U. S. Steel, Amer. Bridge Div. Fabrication.

Glass Fabrics.....Many weaves of glass fabrics engineered for liquid filtration, plastics lamination, high temp. dust collection or insulation. Samples are offered. 154 *National Filter Media Corp.

Insulation The new Industrial Insulation Catalog is offered. Also Data Sheets on the complete line of accessories for use with Foamglass insulation. *Pittsburgh Corning Corp.

Nuclear Graphite.....No other material has so many useful nuclear properties. It is an excellent structural material, resists corrosion & easily fabricated.

*The National Carbon Co.

Protective Coatines......Polyken 960
is a dependable pipeline coating.
Easy to handle, simple to apply,
& its cathodic protection requirements are low.
Details on request.
53
*The Kendall Co.

Silicone Paint.....to resist weathering to resist heat, to resist discoloration and to resist corrosion. Formulating and technical data are offered. *Dow Corning Corp.

Tank Linings.....New Gar-Line Penton linings offer high-temperature protection against corrosion. Data on Penton; information on tank linings. *Garlock, Inc.

Electrical & Mechanical

Electric Trucks.....The exclusive fea-tures that enable these trucks to deliver up to 60% more work in low speeds per battery charge are ex-plained in 12-page brochure. Automatic

odlights......for any explosion-prone area. A catalog is offered giv-ing descriptions of floodlights for explosion-proof illumination. Cat-alog Number 320. explosion-Floodlights. *Crouse-Hinds

Gas Turbines.....Specialized installa-tion, maintenance from Solar's ex-perienced field service engineers. Write Dept. J-168 for info on gas turbines, field service program. 155 *Solar, sub. Internat'l Harvester

М١

^{*} From advertisement, this issue

Aldrich pumps thrive on 24-hour liquid diet of anhydrous ammonia

At five years of age, these two Aldrich Triplex pumps are still at work for Southern Nitrogen Company. Service is continuous (168 hours a week), pump suction 185 psig, discharge 3000 psig, temperature 100 degrees F. No one said the job was going to be easy . . . and Aldrich pumps have once more proved their ability to handle the tough assignments. The only shutdowns required were for routine packing replacement, according to Paul Meyers, Superintendent.

rials

sistant to the micals material arriety of amid Co.

I resists etroleum sion for echnical at Corp.

of all d with titles & dil, truck dge Div.

aves of r liquid on, high ulation.

rial InI. Also
te line
FoamCorp.
matenuclear
structure
struc

thercolor-Fora are Corp. Penature Data tank

Inc.

feas to low

ex-

atic

ion-

givfor at-

nds

lla-

gas

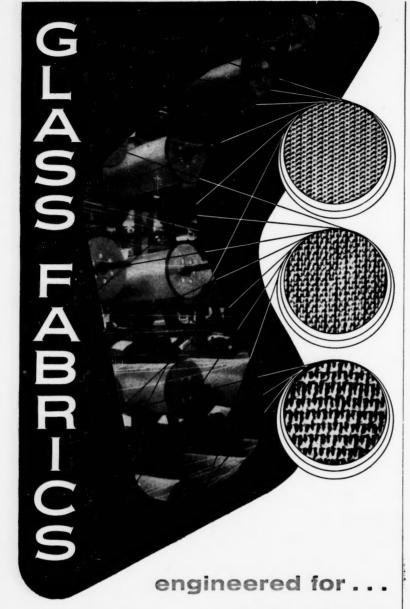
NG

Southern Nitrogen, at its Savannah, Georgia plant, produces a group of nitrogen chemicals. In handling liquid anhydrous ammonia, the Aldrich direct flow, reciprocating pumps have assisted in the production of urea. Pump plungers, valve seats and plates are of 440 C stainless steel for added insurance.

There are very few high pressure applications in the chemical industry that Aldrich pumps have not been called upon to handle. So don't hesitate to present your problem to our engineers—who have solved most pumping specials already. Corrosive, viscous, abrasive, or highly compressible fluids over a wide range of temperatures are now being handled by Aldrich pumps rated from 5 to 2500 hp., and up to 100,000 psi. For quick reference, consult our advertisement in Chemical Engineering Catalog, or write Aldrich Pump Company, 3 Gordon Street, Allentown, Pennsylvania. Remember . . .

THE TOUGH PUMPING PROBLEMS GO TO





•LIQUID FILTRATION

· PLASTICS LAMINATION

HIGH TEMPERATURE DUST COLLECTION - INSULATION

Tell us your application, we will send you samples

Weavers of Industrial Tilter Media for over Tifty Years

NATIONAL FILTER MEDIA Corporation

General Offices and Mills: New Haven 14, Conn.; Western Office and Factory: Salt Lake City 10, Utah, Sales Offices—Representatives: Atlanta, Ga., 990 Lindridge, N.E.; Cleveland 39, Ohio, P.O. Box 9407; Monterey Park (L. A. Area), California, 664 Monterey Pass Road; Chicago, Ill., 6034 N. Cicero Avenue; Houston, Texas, 1607 Jefferson Avenue; Toronto, Ontario, C.P.R. Roadway, 1119 Yonge Street.

LITERATURE . . .

Power Recovery Turbine designed for power recovery from any gas mixture. Further information on any power recovery turbine application is available. Cover "Worthington Corp.

Speed Drives......Adjustable-speed drives in sizes from ½ to 2500 hp. Information is contained in Bulletin 2900, Adjustable Speed Drives, which is available.

58 "The Louis Allis Co.

Speed Reducers 36-page cat includes handbook information. 40 help select right-angle bevel-helical gear reducers and provides rating charts.

154A D. O. James Mfg. Co.

Unilets, Aluminum.....The line includes 7 of the most popular types in ½" ¾" & 1" sizes. Bulletin No. AL 60 includes details for the entire aluminum product line.

1 Appleton Electric Co.

Universal Joints.....6-page engineering bulletin No. 513 describes series of universal joints with torque capacities ranging from 4,250 to 12,700 lbs.-ft.

154B Twin Disc Clutch Co.

Handling & Packaging

Conveyor Belts.....Metal-mesh belts for such diversified operations as bagging cement, drying wool, etc. A 130-pg. Reference Manual gives specifications, etc. 65 *The Cambridge Wire Cloth Co.

Dimple Jacketed Tanks.....This construction saves 20 to 30%. The jacket is ASME approved to 162 p.s.i. Details are found in Bulletin BF-6 which is offered.

105 *Brighton Corp.

Screw Conveyor Components......A
single component or complete systems—for standard or special requirements. Details are available on the complete line to match your need.

16
*Link-Belt Company

Tanks.....Largest seamless reinforced plastic tanks available up to 11½ feet in diameter. For complete info on low cost. corrosion-free service request Catalog No. 110. *du Verre Inc.

Vibrating Screens......48-page booklet 2777A describes ten different types of screens in 214 sizes and contains tables of materials, and cutaway photographs and drawings. 154C Link-Belt Co.

Heating & Cooling

Air Heaters.....Bulletin #AH-61 describes three basic types of single burner gas, oil or combination direct fired units and discusses firing and auxiliary control equipment.

154D Coen Co.

Coils, Smooth-Fin.....offer greater heat transfer per sq. ft. of face area and lower airway resistance—less power per c.f.m. Further details in Bul. S-55.

148 *Aerofin Corp.

^{*} From advertisement, this issue

NEW SUBSCRIPTION APPLICATION

Subscriptions Accepted Only From CPI Engineers, Technical Management and Senior Students. Cards Must Be Filled-In Completely Before Service Starts — Students Please Include Class, Major Field and School. Rates for U.S. and U.S. Possessions Only

3 years of CHEM	ICAL ENGINEERING for \$5	☐ Bill me	
Foreign 1 Yr.: Canada \$4 West. Hem. \$15 • Others \$25	► HERE for 1 YEAR @ \$3	☐ Paymen	enclosed
Name	Title		
Home Address		К	
City	ZoneState		
Company & Department	Approx. No. of Employees in Plant_		
Product(s)	Man	ufacturer M	
10001(0)	BUSINESS ADDRESS	lesaler	12-25-61
Street	CityZoneSta	te	
☐ Check he	re if you want publication sent to business addres	S	

FIRST CLASS

PERMIT No. 64

NEW YORK, N. Y.

BUSINESS REPLY MAIL

No Postage Stamp Necessary If Mailed In The United States

POSTAGE WILL BE PAID BY-

CHEMICAL ENGINEERING

330 WEST 42nd STREET

NEW YORK 36, N. Y.



designed any gas tion on e appli-

n Corp. le-speed 2500 hp. n Bulle-Drives,

Please Print

tion to helical rating

ine inr types tin No. the encric Co. ginee:-

s series torque 250 to

ng

n belts ons as ol, etc. I gives

s con-The to 162

ulletin Corp.

e sysal reble on your

forced o 11½ e info ervice

e Inc. coklet types concut-

ngs. It Co.

dedesingle ation s firquip-

eater area —less etails

Corp.

ING

FIRST CLASS PERMIT No. 64 NEW YORK, N. Y.

BUSINESS REPLY MAIL

No Postage Stamp Necessary If Mailed In The United States

POSTAGE WILL BE PAID BY-

CHEMICAL ENGINEERING

330 WEST 42nd STREET NEW YORK 36, N.Y.



fo

NEW SUBSCRIPTION APPLICATION
Subscriptions Accepted Only From CPI Engineers, Technical Management and Senior Students. Cards Must
Be Filled-In Completely Before Service Starts — Students Please Include Class, Major Field and School. Rates for U.S. and U.S. Possessions Only*

*Foreign 1 Yr.: Canada \$4 West, Hem. \$15 • Others \$25	ICAL ENGINEERING for \$.	☐ Bi	II me II my company syment encloses
Name	Title		
Home Address			ĸ
City	State		
Company & Department	Approx. No. of Employees in Plo	ant	
Product(s)	^ A	Manufacturer	м
	BUSINESS ADDRESS	Wholesaler	12-25-61
Street	CityZone ere if you want publication sent to business add		

ΜI



TURBOMACHINERY EXPERT

Gas turbine users get specialized installation, maintenance from Solar's experienced field service engineers

Solar field service engineers serve Solar gas turbine customers anywhere, anytime. These trained experts know gas turbines. Many have worked with Solar turbine installations for 10 years. They know how to tailor turbines to specific jobs; they know turbine maintenance.

More and more of Solar's versatile, high performance engines are being used in industry where their light weight, high horsepower and small size mean more efficiency. As a new kind of powerplant, however, gas turbines represent changes in existing methods of installation and maintenance. So Solar sells more than gas turbine engines—it sells experienced customer service too.

Solar's customer service department acts fast to help turbine customers. Immediately following receipt of an order, the department makes complete plans for assisting in the installation and operation of the engine.

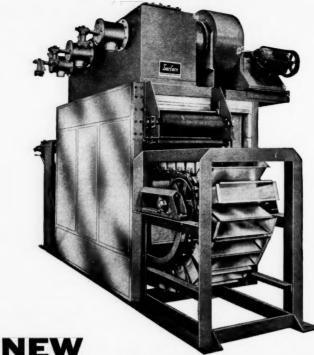
The customer service department's team of field service

engineers is equipped with current passports and security clearances. Their experience and ability equips them to handle field work and to train customer personnel.

Because of Solar's customer service program, companies without gas turbine experience can take advantage of this engine's superior performance. Solar's customer service department offers on-the-spot help and off-the-shelf spare parts for fast, efficient service.

For information about Solar gas turbines or field service program, write Dept. J-168, Solar, San Diego 12, California.

SOLAR 🐺



continuous automatic drying and toasting

This toasting machine, long in development at Kathabar laboratories, may be precisely the means of putting your drying, puffing, and other high temperature processing operations on a continuous basis. Stainless steel trays convey the material, while in a "fluidized" state, through the oven under precise temperature control. Make use of Kathabar's unique fund of hard-earned experience in continuous automatic control of temperature and humidity to speed the processing of a wide range of foods and chemicals.

KATHABAR

where the experts turn for help

SURFACE COMBUSTIO	N, 2380 Dorr St., Toledo 1, Ohio
a division of Midlan	d-Ross Corporation • Ma
Please send facts on \(\Boxed drying \)	toasting for following application:
name & title	
company	
street	
city	zonestate

LITERATURE . . .

Cooler, Aero After.....Gives bests re-sults for compressed air-operated instruments or pneumatic equip-ment. Write for Bulletin 130 you have problem on industrial use of air.

*Niagara Blower Company

Heat Control Equipment such as temperature-pressure regulators, float thermostatic steam traps, thermo-dynamic steam traps and pipeline strainers. Inform. *Sarco Company, Inc.

....Bulletin 500, a Heat Exchangers. 10-page catalog, describes for basic types of bundle type heat exchangers and points out operating advantages of each.

156A Brown Fintube Co.

Heat Exchangers.....Helpful informa-tion on the design and fabrication of heat exchangers and pressure vessels is contained in Bulletins HE and CI which are offered.

*Downington Iron Works, Inc.

Instruments & Controls

Feeder, Merchen......Control of other dry or liquid feeders with pneumatic signals. Response to master signals. For more information write Dept. M-56.29.

*Wallace & Tiernan

Flow Meters w Meters.....Tap-less meters han-dle naphthalene and heavier aromatics without plugging, fouling or leaking. For complete details write for Bulletin 13-31.

*Foxboro Company

cl

it b

Indicator Digital draw-speed indicator instantly reports precise strip process speeds and speed differentials. For further info, write or contact Westinghouse.

151 *Westinghouse Electric Corp.

Industrial pH System.....The all-new Model J pH system is a compact transistorized analyzer with short, rugged electrodes & accessory mounting assemblies. File 14-52-06. *Beckman Instruments, Inc.

ters, Liquid......Helpful metering data available. 28-page technical bulletin lists liquids, helps pick proper sizes and features of meters 2 to 2000 qpm. *Neptune Meter Company Meters, Liquid.

Millivoltmeters......The new 10/20 Series millivoltmeters have all the latest features for indicating, con-trolling & safety cut-off. Tech. 20-21 *Minneapolis-Honeywell

Recorders.....The tremendous power of the 90J (pneumatic) and the 700J (electronic) recorders gives you greater accuracy than ever before. Bulletins 98286 & 98335.

45 *Taylor Instruments, Inc.

Rotameter.... New Varea-meters measure up to 310 gpm water or 1300 scfm air over range of at least 10 to 1. Magnetic indicators, transmitters, accessories available. Dept. -8.29. 158 *Wallace & Tiernan

Thermocouples.......56-page catalog
TC13A contains descriptive information on all products listed and
includes engineering information
concerning usage and application.
156B Barber-Colman Co.

* From advertisement, this issue

МΙ

Birge Wallpapers Use Liquid Meters to Get Fine Color Control

ests re-

equip-130 if crial use ompany

such as

ulators

500, a s four leat exerting ube Co. formarication ressure ulletins

ols

f other
pneumaster
mation

'iernan

s han-

r aro-

mpany

ed inprecise ed dif-

write

Corp.

ll-new

short.

essory -52-06. s, Inc.

tering hnical

neters

npany

10/20

ll the

con-Tech.

ywell

power the

gives

er be-

, Inc.

neas-

st 10

rans-

Dept.

rnan

talog nforand

ation

on.

RING



Color control in wallpapers made by The Birge Co., Inc., depends on adding accurate amounts of water to stains and pigments being ground in ball mills. Before changing over to automatic liquid meters, it took 20 minutes to feed 500 lb. of water by calibrated pails. Now it takes only 10 seconds of a man's time . . . the meters do the rest. Call Neptune for information.

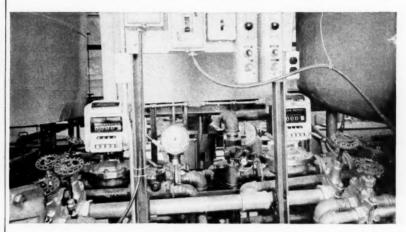
How to Select the Right Liquid Meters



How to save time, labor and ingredients automatically... how to get closer quality control and cost accounting... these involve selection of the right positive displacement meter with the right automatic features. You'll find help in Neptune's "tell how" bulletin. Lists liquids, rates of flow, selector charts, many features such as quantity control and ticket printing. Use coupon at right.

TO REDUCE HAZARDS of corrosive or inflammable liquids, keep them inside the pipes! Meters eliminate dangers of open tanks, dripping gauge sticks, measuring pails, etc. No more accidental contact with liquids or fumes... and you get accurate inventory figures, too. Neptune makes a wide range of meters for such applications. Send coupon at right.

10 Meters Formulate "Aerowax," "Black Flag"



"No other method combines such speed, quality control, cleanliness, economy, and morale," says Boyle-Midway

LOS ANGELES—In designing their new plant for "Aerowax" floor wax, "Black Flag" insecticides and other products, Boyle-Midway, Division of American Home Products decided to scrap the gauge stick, and put in ten meters to accurately control all liquid batching. Ranging in size from 34" to 2", the meters proportion alcohol, "Ubatol", shellac, ammonia, isopropylaminoethanol, kerosene, oleic acid, water, and other ingredients.

Most of the meters are automatic, eliminating human errors. Simply set them for the correct quantities by pressing keys, open the valves, and they will automatically stop the flow at the right point. Some have explosion-proof switches which control pumps or agitators.

Shown here are two 1,000-gal. "Aerowax" vats, with a close-up of the control station which has two 1½" Neptune Auto-Stop stainless steel meters and two ¾" Neptune bronze meters with round reading registers. All are of accurate, trouble-free disc piston type.

You too can benefit by talking over your plans with Neptune.

HELPFUL METERING DATA AVAILABLE

28-pg. technical bulletin lists liquids, helps pick proper sizes and features of meters 2 to 2000 gpm.

NEPTUNE METER COMPANY · Liquid Meter Division 47-25 34th St., Long Island City 1, N.Y.

- ☐ Please send me helpful Meter Bulletin 566S
- ☐ Send Meter Specification Guide 566B



NAME	TITLE	
COMPANY		
	CITY &	
ADDRESS	STATE	

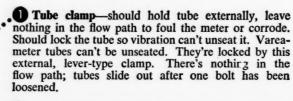
CHEMICAL ENGINEERING—December 25, 1961

157

Before You Buy Any Rotameter

CHECK THESE





2 Tube adapters—should never bind when tubes are removed. The W&T Varea-meter's no-binding adapters let tubes slip out easily without danger of breaking.

3 Float—should be designed to pass the greatest amount of fluid with accuracy, to promote pressure recovery. The shape of the Varea-meter's new highefficiency float restricts flow less, heightens accuracy. It also smooths fluid expansion after the metering disc for a lower pressure drop across the float. Eight or more floats per tube size give a wide choice of capacities.

4 Tube—should have a diameter 1.4 times the float diameter to permit maximum throughput for its size. The Varea-meter tube does. Size for size, the new Varea-meter gives more capacity than any other rotameter. Thus, for any capacity, the smaller Vareameter costs less.

6 O-ring seals—for convenience, should be the same size throughout the rotameter. Varea-meter O-rings are. Since tubes are the same size at both ends, O-rings are identical. The plug for the vertical clean-out seats against another same-size O-ring. Plug threads can't corrode.

 End fittings—should permit piping from all angles; should be quickly removed without breaking down the frame. For convenience, Varea-meter end fittings rotate through 360° and clamp in any position. They are quickly and cleanly removed by loosening a C-ring clamp.

And frames should have strength to protect metering components, permanence to live with corrosion. Vareameter frames are one rigid piece of corrosion-resistant, welded stainless steel. Unitized construction absorbs pipe strain, preserves metering accuracy.

New Wallace & Tiernan Varea-meters measure up to 310 gpm water or 1300 scfm air over a range of at least 10 to 1. Magnetic indicators, transmitters, and accessories are available.

For more information, write Dept. V-8.29.



WALLACE & TIERNAN INC

MAIN STREET, BELLEVILLE 9, NEW JERSE

LITERATURE . . .

ves.....Bulletins are available on rubber-lined iron body gate valves in rising stem, cylinder, & motor operated types as well as on iron body check valves. 107 *Darling Valve & Mfg. Co.

Pip

sol

Expan

ta

et 41 Globe

15

20

m

Pipe,

ir

5

p

Solen

Tubi

Tubi

Valv

Valv

Valv

Val

C

Valves Sleeveline valves offers a larger sealing area, better adjustment, no pocket to collect liquids & solids. Further information in Bulletin V/14.

109 *The Duiron Co., Inc.

Valves.....Catalog GV111B covers control, hose and rotoflo valves and gives specifications, standards, capacity and size charts and other engineering information.

159A General Kinetics Corp.

"Pocket Valve Guide" is offered giving brief spees and cover-age char's on the new Permaturn valve for versatile application to any fluid control service. 95 **Rockwell Mfg. Co.

ves, Ball.....in a full range of pipe sizes from 3s" to 14". A wide range of design variations including sizes from soft of design variations including metal castings of stainless steel, carbon steel, etc.

149 *Rockwood Sprinkler Co.

Valves, Stainless Steel.....All the features of these valves are covered in the Stainless Steel Catalog No. 59SS which is available on request.

*Jenkins Bros.

.are easy-to-install Weld Couplets... fittings for branch connections from pipes, vessels or tanks. Information is contained in Folder SWC-1 is contained in Folder SWC-1 which is available.

*Henry Vogt Machine Co.

rocess Equipment

ators.....Tank Top agitator gives dependable, rugged agitation at low initial and operating cost. Bulletin 581 gives further information and is available. *Nettco Corp.

Air Separators.....offer precise separation and improve screening. Increase 40 to 400 mesh output as much as 300%. For further information Bul .087 is offered.

119 *Sturtevant Mill Co.

'entrifugal......Continuous Solid Bowl type for low cost solid-liquid sepa-rations involving moderate vol-umes, or limited space or extra powerful separating forces. Details. 2 *Bird Machine Co.

rsolvers.....Multiaction turbopel-ler combines five mixing actions in one for most efficient product dispersion. Write for detailed in-Daysolvers. formation. 115a *The J. H. Day Co.

Demineralizers....Two-bed demineralizers designed in capacities of from 300 to 3000 gallons per hour. "Extras" are part of complete package. Catalog #160. 150 *Barnstead Still & Sterilizer Co.

Drying Equipment....Kathabar equipment for toasting or drying. Complete data are available on request for further information on these systems.

*Surface Combustion

* From advertisement, this issue

ailable on te valves

Mfg. Co. offers a r adjust-et liquids ation in

Co., Inc. vers conandards nd other ics Corp.

uide" is d coveration to Mfg. Co.

of pipe ncluding s steel kler Co. he fea-

ered in og No. request. s Bros. -install as from

mat SWC-1 ne Co.

gives at low ulletin and is Corp.

sepa-. In-ut as inforll Co.

Bowl sepa-volvol-extra e Co. opel-

tions duct in-Co.

eral-from 'Exage. Co. uip-

omuest ese

ion

G

& motor

plex Tubes More than 125 Du-plex combinations are available to solve a wide range of corrosion problems in oil, chemical, power & food processing industries. Bul. Duplex Tubes . . . *Bridgeport Brass Company

Pipe, Fittings & Valves

Expansion Joints Catalog 56 contains complete & comprehensive engineering data for expansion joints from 3 inches to 50 ft. diameter. etc. *Zallea Brothers

Globe Valves. service. Walworth Co.

Low Flow Valves.....The new Series 1400 valve body gives a choice of actutor-body combinations to 1400 valve book actutor-body combinations match your applications. Details are to be found in Bulletin B803-1.

*Minneapolis-Honeywell is in-

Pipe, Glass.....Kimax glass pipe is indifferent to the attack of most acids and alkalis and is economical in both installation and maintenance. Information.

*Kimble Glass Div. of Owens-Illinois

Pipe, Pyrex....to solve your corrosion problems completely. Available in all standard sizes and fittings. Bul-letins are offered for more complete details. 64 *Corning Glass Works

Solenoid Valve.....Two-way solenoid controlled coolant valve used to control fluids normally corrosive to non-ferrous materials is described in bulletin 8352. Automatic Switch Co. 158B

oing.......In a wide selection of seamless and welded and drawn up to 1" O.D. Available in a wide se-lection of metals and alloys. Bul-letin #13 is offered. 31 *J. Bishop & Co. Tubing.

Tubing.....You can count on welded carbon or stainless steel tubing in critical heat transfer applications. Booklet 8591 is offered for further information. 97 *Welded Steel Tube Institute

ve.....Sampling valves assure perfect sealing by two compressible replaceable Teflon rings. A new catalog page is available for further information.

B125 *Strahman Valves, Inc.

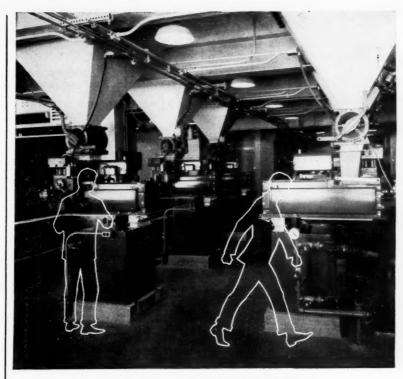
Valve Operators.....Complete line of cylinder type valve operators for plug, ball and other rotary valves is described in bulletin 3050 that gives dimensions etc.

158C Ledeen, Inc.

ves.....New globe valve is redesign and conversion of sizes 2" and larger. For details on this and other stainless steel and corrosion re-sistant valves ask for Bul. #7. 116 *Alloy Steel Products Co.

Valves.....DEMI miniature packing-less valves offer great porting ver-satility in isolating, routing & by-pass applications. Catalog D-1 is offered for details. 162 *G. W. Dahl Co., Inc.

* From advertisement, this issue



SET IT...FORGET IT...

THE W&T MERCHEN FEEDER

When your dry blending or batching process calls for accuracy hour after hour, you need Merchen Feeders. Wallace & Tiernan Merchens feed like clockwork without attention . . . never waver in even the most exacting use.

Their 0.1% sensitivity means that a change as small as 1 ounce in a 63-pound belt load automatically corrects the feed gate setting. You get continuous delivery at set feed rate. And you get true gravimetric feeding. Merchens are never affected by density changes. They self-adjust. You select the feed rate; the Merchen does the rest.

And Merchens give you the other qualities you look for in a feeder: minute-to-minute accuracy within ±1%, rigid, vibration-free construction, compact size, versatility. With Merchens you can control other dry or liquid feeders with pneumatic signals. Or you can use Merchens as slaves, responding to master signals.

For more information, write Dept. M-56.29.



WALLACE & TIERNAN INC.

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY





PRESSING — DRYING and COOLING Equipment

Continuous DeWatering Presses

ROTARY DRYERS Steam Tube, Hot Air and Direct Fire

ROTARY COOLERS Water and Air

MAKE THIS SIMPLE TEST

Pick up a handful of your wet material and squeeze it. If you can remove surplus moisture without difficulty and retain solids in your hand, it is quite possible that a Davenport Continuous Press will do a very satisfactory job of mechanically removing moisture for you.

Let us send you our complete catalog "A". For quick reference, see the CHEMICAL ENGINEERING CATALOG



Davenport Continuous Presses are available in three sizes.

DAVENTORT MACHINE AND

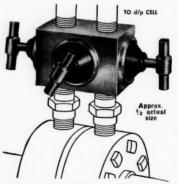
A DIVISION OF
MIDDLE STATION
CORPORATION
DOVERDORY, IOWG, U.S.A.

G. W. DAHL . G. W. DAHL . G. W. DAHL . G. W. DAHL

LOW COST VALVE MANIFOLDS ELIMINATE BY-PASS VALVES, FITTINGS, PIPING!

Dahl DEMI Miniature Packless Valves offer great porting versatility in isolating, routing and by-pass applications. For example...three-way manifold, used across a flow metering, differential sensing device allows it to be zeroed or isolated from line for test . . . reducing size and cost of installation.

Patented basic design offered in forty-three styles . . . with metal-to-metal seating, TEF-LON seats, or neoprene dia-



0

٤

٤

9

5

9

phragms . . . all featuring bubble tight shut-off.

Low cost "DEMI G" valves, in 1/8" to 1/2" N.P.T. sizes, provide positive control in minimum space. Many actuating devices. Wide selection of construction materials.

REQUEST free 32-page Catalog D-1 for complete details. G. W. Dahl Co., Inc., 84 Tupelo St., Bristol, R. I.

G. W. DAHL CO., INC.

SPECIALISTS IN COMPACT VALVES AND CONTROLS

G. W. DAHL . G. W. DAHL . G. W. DAHL . G. W. DAHL

LITERATURE . . .

Drying Systems Instantaneous
Drying Systems process fine wood
fibers, filter cakes, sewage sludge
and other types of particulate
solids. Literature.

118 *Edw. Renneburg & Sons Co.

Mixi

Press

T160

RDC

Ribb

Pun

Acid

Air

Allo

Cen

Con

Mis

Filter Assemblies.....Bulletin A4 contains general introduction to filters, followed by 32 data sheets with cross-sectional drawing, rated flow, pressure drop etc.

160A Aircraft Porous Media Inc.

Flo-Screen Filters.....Available in 8 graded porosities. Offers complete absence of particle migration and extremely rapid flow rates. See Bulletin MF-G1.

122c *Selas Flotronics

Magnetic Separators.....for your wet concentration and magnetic recovery problems. Exclusively the drum type. Details are contained in Catalog 945.

56 *The Jeffrey Mfg. Co.

Micro-Filters.....Series C Micro-Filters available in seven grade porosities. Interchange of element grades. Complete facts in Bulletin MF-Gl. 122a *Selas Flotronics

Micro-Filters.... Series M Micro-Filters offer high mechanical strength plus ability to handle corrosive fluids at high temperatures. Seven grade porosities. Bul. MF-G1.

122b *Selas Flotronics*

Mills3-Roll Mills produce dispersions of the highest possible quality of all types of printing inks, plastisols, paints, etc. Write for detailed information.

115h *The J. H. Day Co.

Mills.......Hy-R-Speed Mills grind, homogenize and blend all types of materials, flowing or paste, in one operation. Write for detailed information.

115i *The J. H. Day Co.

Mills.....Impact Mills offer improved product quality, elimination of bottleneck trouble-free efficient operation. Write or phone for info and free lab test service.

123 *Entoleter Inc.

Mixer.....Titan Mixers are unsurpassed for processing solid rocket propellants and other materials requiring precision mixing. Write for detailed information.

115d *The J. H. Day Co.

Mixer......Regal Mixers give unique agitator action which reduces mixing time as much as 50% over other methods. Write for detailed information.

115g *The J. H. Day Co.

Mixers.....Mix-Muller saves valuable raw materials and in many cases eliminates secondary processing. Details on a laboratory conducted survey & Handbook on Mulling.

63 *National Enginering Co.

Mixers, Pony......A model for every need with single motion or twin motion mixing action, 1 or 2 speed motors. in working capacities from 3 to 125 gal. Bul. 500. 115e *The J. H. Day Co.

* From advertisement, this issue

160

DAHL

3

ö

DAHL

3

ö

Mixing Column.....CMContactor new multi-stage mixing column handles anything that flows. Combines a mixer and process vessel, designed to fit your needs.

172 *Mixing Equipment Co.

ataneous

ne wood sludge e sludge rticulate

Sons Co.

A4 con-o filters, ts with

dia Inc.

le in 8 omplete

on and s. See tronics ur wet ic re-

itained fg. Co.

ro-Fil-

porosi-

rades.

ronics

o-Fil-

ength rosive Seven

ronics

isper-

quali-

plas-

y Co.

grind.

one in-

y Co.

bot-

pera-

and Inc.

sur-

cket re-for

Co.

new

king

arts

Co.

que

ixiled Co. ble

Ses ted Ċo.

ed m

Co.

NG

for

with ed flow. ss, Continuous...... Mechanically removes moisture from wet mate-rial. Information listed in complete catalog "A." Available free on re-

quest. *Davenport Machine & Foundry Co.

C Column.....combines many advantages such as high volumetric efficiency, high throughput capacity, elimination of interstage settling, etc. Bul. T-1159.

*General American Transp. Corp. RDC Column . .

Ribbon Blenders....in a variety of materials..... with powerful drives ... and various types of agitators ... in capacities that range from 7½ to 3850 gal. Bul. No. 800.

115c *The J. H. Day Co.

Ro-ball Sifters Superactive ballcleaning action provides fast, ac-curate sifting. Single and multiple screen models. Write for detailed information. *The J. H. Day Co.

Pumps, Fans & Compressors

d Pumps......with rugges, simple frame construction & packingless design. Long wear parts, few in number, are available in a variety of metal alloys as well as plastic.

171 *A. R. Wilfley & Sons, Inc. Acid Pumps...

Air Compressors......8-page catalog lists specifications for 43 different compressors and gives complete in-formation on selection and sugested uses. 161A Wayne Pump Co.

Alloy Pump......Model 3139 is constructed of ISO-40, a stainless steel alloy which is highly resistant to corrosion and abrasion. Further information is available.

33e *Goulds Pumps, Inc.

Centrifugal Pumps......for handling a variety of requirements. A com-plete line of pumps is available along with various types of comoressors. *Ingersoll-Rand

Compressors.....12-page bulletin 206 describes two-cycle turbocharged gas-engine-driven compressors for pipeline, gas storage and process applications.

Clark Bros. Co.

Mised-Flow Pumps......4-page bro-chure 211-1 describes pump and in-cludes a cross-section of pump along with dimensions and per-formance curves plus illustrations. 161C Lawrence Pumps, Inc.

Pump, Chemical Process Model 3195 pumps simplify process engineer-ing and cut parts inventories. They offer maximum interchangeability. Bulletin is offered.

33a *Gould Pumps, Inc.

Pump, Vacuum.....The new Series H
Microvac pump is designed for
compactness. Information about
this type plus a Vacuum Slide Calculator are offered.

120 °F. J. Stokes Corp.

• From advertisement, this issue

here's why **most** plant engineers prefer WEINMAN

Handling of liquids . . . for heating, cooling and processing . . . is an important facet of modern manufacturing. The tremendous volume of fluids handled prompts today's industrial engineer to find ways of insuring a steady flow of vital liquids to and from the job. That's why more and more engineers are turning to Weinman to meet their precise pumping requirements. And, they find plenty of reasons to back their buying decision:

> 1 WEINMAN EXPERIENCE. More than 50 years of pioneering developments that are today's standards assures you of the right pump for each job.

> COMPLETE PUMP LINE. Every type of centrifugal pump to meet any pumping need. You're sure that the pump you buy is the best pump for the job.

QUALIFIED RECOMMENDATIONS. Made after a careful analysis of your present and future pumping needs. You get the pump that fits your job today and

SIMPLE DESIGN AND RUGGED CON-**STRUCTION.** Weinman Pumps are built for easy maintenance and long, troublefree service.

INSTALLATION AND SERVICE. You get skilled assistance before, during and after installation to insure proper operation twenty-four hours a day.

When you're faced with a pumping problem . . . get the right answer from your Weinman specialist . . . you'll find his name in the Yellow Pages. Or, write to us.



Immersible Non-Clog Pumps





Single Stage, d Suction Pumps

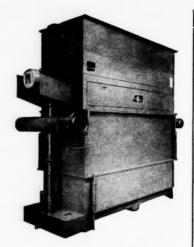
COLUMBUS 15, OHIO CENTRIFUGAL SPECIALISTS

How to get drier or cooler AIR or GASES

at low cost

NIAGARA AERO® AFTER COOLER cools a compressed gas, or air, below the temperature of the surrounding atmosphere, thus preventing the condensation of moisture in your lines. The gas will contain only half of the moisture left in it by conventional methods. Even drier gas can be produced if you require it.

In working with controlled atmospheres of inert gases to prevent undesired reactions, this dryness of the gas at low cost is a great advantage. The cost of the Niagara method is low because it uses evaporative cooling, saving 95% of the cost of cooling water (and its piping and pumping). This direct saving of cost pays for the Niagara cooler in less than two years.



If you use compressed air to operate instruments or pneumatic equipment you will get better results by using the Niagara Aero After Cooler.

Write for Bulletin 130, or ask nearest Niagara Engineer if you have a problem involving the industrial use of air.

NIAGARA BLOWER COMPANY

Dept. CE-12, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U.S. and Canada

What book shows you how to make accurate estimates of costs and profitability...



COST ENGINEERING in the PROCESS INDUSTRIES

of course!

Over 500 pages of practical "how to" information reprinted from Chemical Engineering. Published by McGraw-Hill Book Company. Price \$11. Order direct or through

Reprint Department Chemical Engineering 330 West 42nd St., New York 36, N.Y. LITERATURE . . .

Pumps.....Corrosive, viscous, abrasive or highly compressible fluids over wide temperature range are handled by pumps rated from 5 to 2500 hp. and up to 100.000 psi. Write.

153 *Aldrich Pump Company

Pumps.....16-page catalog 500 describes and illustrate complete line of "U" type pumps for continuous metering and proportioning of small volume flows.

162A Hills-McCanna Co.

Pumps.....Triplex pumps save packing failure at high pressures. Available in 120 different cylinder designs to meet every product problem.

*Manton Gaulin Mfg. Co.

Pumps......Bulletin 47740 describes complete line of electrohydraulic servo controlled pumps and system components and details how they work and where they are applied 162B The Oilgear Co.

Pumps.....Complete pump line, qualified recommendations, simple design and rugged construction, installation and service plus experience. Write today for information.

161 *Weinman Pump Mfg. Co.

Pumps and Motors.....5,000 psi piston pumps and motors useable in a wide range of power transmission applications and featuring a variety of controls described in bulletin. 162C Vickers Inc.

Services & Miscellaneous

Control Valve Noise.....Technical manual TM-9 presents problem of noise emitted by control valves and explains how sonic vibration can be damaging to equipment.

162D Fisher Governor Co.

Corresion......60-page booklet "The Role of Molybdenum and Copper in Corrosion Resistant Steels and Alloys" contains numerous charts, graphs and tables. 162E Climax Molybdenum Co.

Dialysis..... A separation method utilizing diffusion as its driving force is discussed in technical paper T-186 "Dialysis for Acid Recovery". 162F Graver Conditioning Co.

Fire-Fighting Products....Foam liquid binds large volumes of air & water into an effective low cost extinguishing agent for fighting any type of fire. Inform.

23 *Rockwood Sprinkler Co.

Maintenance Record Cards.....Easyto-use cards for keeping pump maintenance records are offered. Help in ordering new parts. scheduling lubrication, etc. 33b *Gould Pumps, Inc.

Profession Advancement......Booklet E-7 is available on request as one of a series on personal and professional advancement which has been prepared for engineers. 114 *Western Supply Co.

Safety Equipment.....28-page catalog describes latest types of emergency deluge showers, aerated eye and face wash fixtures and water spray accessories.

162G Speakman Co.

^{*} From advertisement, this issue

Employment Opportunities

brasive ds over

nandled

mpany

te line

f small

na Co. Avail-

roduct

fg. Co.

scribes

draulic

system v they they

ar Co quali-le de-

iction, xperi-

g. Co.

piston in a ission ariety

tin. s Inc

US

inical

m of and an be

r Co.

"The

er in

arts.

1 Co.

util-

orce

aper ery".

Co

quid

ater

any

Co.

asvimp rts.

Inc

klet one

es-

has

Co.

log

nd

ter

Co.

NG

00

CE's nation-wide coverage brings you tips and information on current opportunities in job functions throughout the chemical process industries.

- ▶ Displayed Rates—\$62.00 per inch for all ads except on a contract basis: contract rates on request. An advertising inc't is measured I in, vertically on a column; 3 columns, 30 in. per page, Subject to the usual agency commission.
- ► Undisplayed Rates—\$2.40 per line, 3 lines minimum. To figure advance payment count 5 average words as a line; box number counts as 1 line, 10% discount if full payment is made in advance for 4 consecutive insertions. Not subject to agency commission

CHEMICAL **ENGINEERS PROCESS IMPROVEMENT**

The Chemstrand Corporation—a leader in the field of chemical textile fibers—is seeking chemical engineers for assignments involving process and product improvement. Such assignments include process analysis and evaluation, machine and equipment modification, as well as technical assistance on day to day process problems. Current openings, which offer unusual opportunities for advancement, are in the Pensacola, Florida and Greenwood, South Carolina nylon plants and in the Acrilan® Plant and Chemstrand Technical Center located in Decatur, Alabama.

These progressive southern cities offer a pleasant climate, attractive living, cultural and recreational opportunities.

Send resume of academic training, experience and salary history in confidence to: Manager, Employment-Recruitment, Dept. N-3, The Chemstrand Corporation, 350 Fifth Avenue, New York 1, New York.

HEMSTRAN CORPORATION 350 FIFTH AVENUE NEW YORK I NEW YOR



Chemical Engineers

Process and project engineers for expanding Central Engineering Department engaged in process development, equipment and plant design, economic evalua-

Requirements

BS or MS in Chemical Engineering with 2-10 years experience in inorganic, heavy organic or electrolytic processes preferred.

Location in attractive area of Central New York State.

Send detailed resume to

Personnel Supervisor Solvay Process Division Allied Chemical Corporation P.O. Box 271 Syracuse 1, New York



San Francisco

Bechtel Corporation offers immediate employment opportunities to chemical engineers experienced in process design of major petrochemical, refinery, or similar processing units.

Liberal transportation and relocation allowances for you and your family. Please send resume of experience, includ-ing present and required salary, to W. A. Anderson, Technical Recruiting.

Bechtel Corporation

220 Montgomery Street San Francisco, Calif.

ENGINEERS

SENIOR PROCESS SENIOR PROJECT

McKEE offers exceptional career opportunities to men qualified by experience with engineering contractors engaged in the design and construction of petroleum, chemical and petrochemical plants.

> Send detailed resume to: G. VICTOR HOPKINS

ARTHUR G. McKEE & CO. 2300 Chester Ave. Cleveland 1, Ohio

CHEMICAL ENGINEER

McKee has a challenging position in Cleveland for a chemical engineer in the ammonia field. Candidate should have at least 10 years of diversified chemical engineering experience, with several years in the design of ammonia plants.

> Send detailed resume to G. Victor Hopkins

ARTHUR G. McKEE & CO.

2300 Chester Ave.

Cleveland 1, Ohio

WANTED-ENGINEER

experienced in Ore Beneficiation Plant layout design and capital cost estimating. Excellent opportunity. Location: Northern Minnesota. Reply

P-7869, Chemical Engineering 645 N. Michigan Ave., Chicago 11, Ill.

SALES ENGINEER

for LOS ANGELES Area ior LU3 ANGLES Ared
to sell Heat Exchangers, Steam Generators, Tubelee Machines. Must be graduate engineer with
experience in one of these fields. Write to Dept.
24A

HENRY VOGT MACHINE CO Louisville 1, Kentucky P. O. Box 1918

PROFESSIONAL SERVICES

CARL DEMRICK

Technical Translations

Send for Circular Yonkers, N. Y. 53 So. Broadway

Equipment Searchlight

CE's Searchlight spots the big bargains in used, resale and rented equipment. Check this issue's listings-most complete in the field—for items you need now.

- ► Coverage National. Equipment and facilities-used, resale and rental-for the process industries. For sale, wanted, for
- ▶ Rates—\$25.00 per inch for all ads except on a contract basis; contract rates on request. An ad-
- vertising inch is measured 3 in. vertically on a column; 3 columns, 30 in. per page. Ads acceptable only in display style.
- ► Closing Date January 22nd issue closes December 29th. Send all new ads to Chemical Engineering, Classified Adv. Division, P. O. Box 12, New York 36, N. Y.

BEST VALUES

Evaporators: Four St.St. Buflovak dbl. eff. 608-708-845-1125 sq. ft. each. Long tubes.

Evaporators: Five St.St. spl. eff. 94-150-216-450-800 sq. ft. each. Long tubes.

Vacuum Pan, Royers 6 ft. with make up tanks. All St.St.

Votator: Girdler three $4^{\prime\prime}$ x $46^{\prime\prime}$ stainless cylinders and rotors, ammonia chilling system.

Vacuum Drver: Stokes 2" x 6" Rotary, jacketed, St. St. With drive, condenser, receiver, Dryers: Double Drum, 42 x 90: 32 x 120 Buflovak, Dryers: Double Drum, 42 x 120: 36 x 84 American.

Dryer: Proctor & Schwartz, 12' wide multi-pass St.St. conveyor.

Dryer: Raymond Flash Dryer and Cooler with cyclones, furnace, ducts, etc. 20,000#/hr. Neverused.

Twin Shell Blenders: P.K. 5 cu. ft. St.St.: P.K. 30 cu. ft. steel with intensifier.

Centrifuges: Tolhurst 40" and 26" Suspended, Perf. Centrifuge, Sharples Model DH2, Nozzle jector.

TANKS: St.St.—(20 in stock) 4000 gal. to 500 gal. Vertical and horizontal. Atmospheric and Vacuum type. Some with coils.

Kettles: (2) 600 gal. agitated St.St.; with 15 P.S.I. steel jacket.

Glass Lined Kettle: 750 gal. Pfaudler, 50 PSI shell, 90 PSI jacket; agitator. ix Muller: Simpson, Size #2, 1000 lb. St.St. 15 H.P. drive.

BEST EQUIPMENT COMPANY

1737 W. HOWARD ST. CHICAGO 26. ILL. AMbassador 2-1452

CIRCLE A ON READER SERVICE CARD

SPECIAL BARGAIN OPPORTUNITIES

3000 KW, 3600 RPM, 80% P.F., 3/60/13,800 V., UNUSED Allis Chalmers non-condensing automatic extraction steam turbine gen-erator unit, 425 PSIG, 700-750°FTT, 170 PSIG automatic extraction, 60 PSIG back

1500 KW, 3600 RPM, 80% P.F., 3/60/2300 V., General Electric non-condensing steam turbine generator unit, 375 PSIG, 650-700°FTT, 85-125 PSIG back pressure.

NEW, UNUSED Babcock & Wilcox coal pulverizer, Type E-56, equipped with American Blower Corporation air fan, 15,000 CFM capacity with motor drive. Complete coal pulverizer installation with blower air fans, attached and unattached structural parts, capacity 14,600# per hr.

This excellent equipment is offered at a fraction of replacement cost.

Utilities Machinery Corporation 912 National City E. Sixth Bldg. Cleveland 14, Ohio Telephone CH-1-0210

CIRCLE B ON READER SERVICE CARD

OVER 5.000 MACHINES IN STOCK FOR EVERY INDUSTRY AND PURPOSE

Filter presses

Wrappers
Packaging machines
Cartoning machines
Fillers
Labelers

Mixers
Pulverizers
Grinders
Dryers
Sifters

TELL US YOUR REQUIREMENTS

Complete Details And Our Special Low Bargain Prices Available On Request

UNION STANDARD EQUIPMENT CO.

318-322 Lafavette St., New York 12, N. Y. Phone: Canal 6-5333-4-5-6

CIRCLE C ON READER SERVICE CARD

FOR SALE WYSSMONT TURBO DRYERS

5-Rotating Tray type, Model No. VTL-24, Tray, with tray and fan drives. Includes externally mounted 4-coil Steam Heat Exchanger, and motorized Blower to heat air to Dryer. Further information and price on

DALTON SUPPLY CO.

2181 E. Huntingdon St.

Phila., Pa.

CIRCLE D ON READER SERVICE CARD

Pfaudler 10 gal. Glass Lined Kettle Hersey 5'x26' Rotary S.S. Dryer Buffalo 32"x90" Double Drum Dryer Day Hy-R Speed Mill 20 HP XP SEND FOR LISTINGS

STEIN EQUIPMENT CO. -8th Street Sterling 8-1944 Brooklyn 15, N. Y.

CIRCLE E ON READER SERVICE CARD

JANUARY SPECIALS

Stokes vac. shelf Dryer 2 shelf 40" x 42" Buflowak 4" x 8" Lab. SS double drum Dryer Day 7-40 imperial jkt. Mixer, 150 gal. wk.,40hp exp. Abbe 5"x6" jktd. Bail Mill, chrome mang, steel Pfaudier 1500 gal. gass lined Tank, closed top Simpson 24" Lab. SS Mix Muller, 1½ HP motor Gruendier 23 Hammermill, Whirlbaster, 22" 2 Fitz Mills Model D. 5 HP motors Albhon Blenders, Steel & SS, all sizes, new & Used

WHAT HAVE YOU FOR SALE OR TRADE? YOU CAN BANK ON

EQUIPMENT CLEARING HOUSE, INC.

111 33 Street, Brooklyn 32, N. Y. SOuth 8-4451-4452-8782

CIRCLE F ON READER SERVICE CARD

HOW to LOCATE EQUIPMENT

without cost or obligation

This service is aimed at helping you to locate Surplus New or Used equipment, if you do not find your present requirements advertised in this section.

Send us the specifications of the equipment wanted and you will receive an immediate reply with full

EQUIPMENT FINDERS BUREAU SS-6663, Chemical Engineering Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

CIRCLE G ON READER SERVICE CARD

WANTED

Pressure vessel to handle live steam at 60 psi. Used for rubber witcanizing Must be ASME Coded belief or outside the state of the state

W-7941 Chemical Engineering Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

CIRCLE H ON READER SERVICE CARD

WATER UNLIMITED!

Strikes? Unknown, Location?—Fort Madison, Iowa Plant—33,000 feet—modern—one floor—Sprinklers Office? — modern, air conditioned. PRICE? — COULDN'T BE MATCHED! FINDERS FEE PAID.

C. A. BUCKSTEN
209 So. La Salle Street Chicago 4, III.

CIRCLE J ON READER SERVICE CARD

TURBO-GENERATORS . DIESELS PUMPS • FANS • BURNERS • HEATERS

Large Selection . . . New and Used EXPERIENCED ENGINEERS TO ASSIST YOU



WABASH

POWER EQUIPMENT CO. **PHONE IN 3-0303** 3300 W. PATTERSON AVE. CHICAGO 45, ILL.

CIRCLE K ON READER SERVICE CARD

2-New 5000 Gallon Pressure Vessels Mfgd. by Babcock & Wilcox. ASME rated, 1750# oper, press.; 3572# press, tested, 650 deg. F max. temp.; Weight 80,500# Blt. 1952. Size 23' L x 53" I.D. With piping, valves, fittings, etc. Pressure pumps-all sizes and kinds available.

EVEREADY-Box 1780-Bridgeport, Conn. Ed McCallum ED. 4-9471

CIRCLE L ON READER SERVICE CARD

YOUR S BUYS MORE

DAY STAINLESS MOGUL MIXER

200 gallon working capacity. Heavy double nobben cored agitator blades. Jacketed for 125 PSI pressure, vac cover code constructed. 75 HP expl proof motor and drive. Purchased new 1959. Original cost \$45,000.00.

SAVE MANY THOUSANDS



CIRCLE M ON READER SERVICE CARD

LIQUIDATIONS

CLEVELAND, OHIO

ing

sed

our

in

the

will

full

U

. Y

V

FF

11

CARD

RS

d

D.

F

ARD

Is

ARD

RD

VG

CARD

CARD

-Raymond #73612 Super High Side 6-Roll Mill, with whizzer, cyclone, piping and motors.

Raymond #5047 High Side 4-Roll Mill, with whizzer, cyclone and pip-

ing. -#1 Raymond Impact Mill, with whizzer, cyclone and piping.

-Kilby Nickel Single Effect Force Feed Evaporator, 1200 sq. ft. -Oliver 5'3" x 4' Nickel Clad Rotary

Vacuum Filters.

-Feinc 8' x 12' Rotary Vacuum Steel Filters, string discharge.

Filters, string discharge. –6'6'' dia. x 60' Rotary Dryers. –5'/2' x 4'/2' x 50' Rotary Dryer. –Dorr 80' and 40' thickeners. –Tyler Hummer 3' x 10' Double Deck

-Fuller Kinyon Pumps H6. -Link-Belt 24" x 90' Belt Conveyor. -Nickel Centrif. Pumps, 2", 3".

JUST PURCHASED

NEW-1957-1959

-Glascote 1500 gal. jacketed, agi-tated Reactors, 100# Jacket, 100#

-Glascote 500 gal. jacketed, agi-tated Reactors, 75# Jacket, 75#

Oliver 5'3" x 4' Rotary Vacuum Pre-

coat Combination Filter, 304 SS. -Oliver 3' x 2', 3' x 6' Rotary Vac-uum Filter, 304 SS.

-Sharples DH2 Nozljectors, 316 SS, 20 HP.

-Baker Perkins S15 Ter Meer Con-tinuous Centrifuge, 304 SS. -316 Stainless steel Bubble Cap Col-umns, 24", 30", 42", 48", 54", 60"

-Dowtherm Boiler 12,000,000 BTU.

CENTRIFUGES

- 2-Bird 18" x 28" Solid Bowl Continuous 304 S.S.
- -Bird 40" x 60" Solid Bowl Continuous 316 S.S. UNUSED.
- -Sharples C-20 and C-27 Super-D-Hydrators 316 S.S.
- -DeLaval AC-VO Continuous S.S. 20 HP.
- Sharples PY14, PN14 Super-D-Canters 316 S.S.
- -Sharples #16, 304 S.S., 3 HP motor.
- -Tolhurst 40" 347 S.S. imperforate basket 15 HP. UNUSED.
- -Bird 40" Suspended imperforate basket 40/10 HP.

BRILL FOR VALUES

REACTORS-EVAPS-CONDS-COLUMNS

- -Glascote 500 gal, glass lined, Jacketed Reactors.
- Pfaudler 125 gal. 304 S.S. Jkt. Agit. Reactor, 150# int., 125# jacket.
 -Pfaudler 300, 200, 100 and 50 gal.
- glass lined jacketed, agitated Reactors. 650 gal. 304 S.S. Reactor with 100
- sq. ft. Bayonet Heater. 8650 sq. ft. NICKEL double effect forced
- Circulation Evaporator, UNUSED. 3000 sq. ft. O. G. Kelly 309 S.S. forced feed Evaporator, UNUSED.
- 550 sq. ft. Buflovak monel single effect
- Evaporator. 300 sq. ft. Swenson 347 S.S. Single Effect Evaporator.
- -250 sq. ft. Buflovak 304 S.S. Single Effect Evaporator.
- Stainless Heat Exchangers; 910, 536, 370, 250, 131, 70 sq. ft.
- -Pfaudler 26 sq. ft. glass lined Condensers. -4'6" x 46' 316 S.S. Clad Column, 250
- PSI. -3' x 20', 30" x 19' 347 S.S. Packed
- Columns 1-24" x 35' 304 S.S. Bubble Cap Column.

FILTERS

- 2-Niagara 370 sq. ft. Vert. 304 S.S.

- -Niagara 110 sq. ft. Vert. 316 S.S. -Niagara 92 sq. ft. Vert. Jkt. 16 S.S. -#10 Sweetland, 36 leaves 3" centers.
- #5 Sweetland 304 S.S., 120 sq. ft. Sperry 30" C.I. Filter Press, 27 chain-
- Oliver 6' dia. Horizontal 316 S.S.
- Oliver 4' dia. Monel Horizontal.
- U. S. 200 sq. ft. 304 S.S. Auto-Jet.
- Hercules 400 sq. ft. 304 S.S. Pressure.
- 3-Oliver Precoat 5' x 6', 5' x 10', 8' x 10'.
- Oliver 5'3" x 8' Steel Rotary Vac Housing.
- -Feinc 3' x 1' 316 S.S. Rotary Vac.

DRYERS

- 1-Buflovak Vacuum Shelf, 17-60" x 80" shelves.
- 2-Buflovak 42" x 120", atmospheric double drum complete.

 -American 42" x 120"
- Atmospheric Double Drum Dryer, complete.

 -Buflovak 32" x 90" Atmos. Twin Drum.
- 2-Devine 4' x 9' single drum, atmospheric.
- 1-Buflovak 48" x 28" C.I. Single Drum
- 1-Buflovak 3' x 10' Rotary Vacuum.
- 6—Louisville Rotary Steam Tube, 6' x 30'. 6' x 50'.
- 2-Louisville 8' x 50' Stainless Steel Lined Rotary.
- 3—Rotary Dryers 6' x 50', 7' x 80', 8' x 80'.
- -Link Belt 6'4" x 24" Roto Louvre 316

- 1-Link Belt 3'10" x 16' Roto Louvre.
- 1-4' dia. 304 S.S. Spray Dryer.
- 1-Wyssmont, 304 S.S. 6'2" dia.

MIXERS-MILLS

- 1-Sturtevant 75 cu. ft. 304 S.S. Rotary Batch Blender 20 HP.
- -Abbe 110 gal. 304 S.S. Jacketed Agitated Vacuum Dispersall Mixer.
- 2-Baker Perkins 150 and 100 gal, Jacketed double arm Sigma blades.
- -Baker Perkins 50 gal. jacketed.
- 5-Day "Cincinnatus" double arm, 250 and 100 gal.
- 1-Steel jacketed Powder Mixer, 225 cu. ft.
- 1-Day 215 cu. ft. Jumbo Powder Mixer 316 S.S., 30 HP motor.
- 1-Day 120 cu. ft. Jumbo Powder Mixer, 25 HP motor.
- 45" dia. Lancaster Mixer 71/2 HP.
- 3-Hardinge 6' x 36", 5' x 22" and 3' x 24". steel lined conical Ball Mills.
- 2-Mikro Pulverizers, 2TH and 1SI.

TANKS

- 25-500 to 3500 gal. Vertical 304 S.S. Tanks opened and closed, some agitated.
- 6-7500, 6000 and 2000 gal. Rubber Lined Tanks.
- -1500 gal. Stainless Pressure Tank, 5' x 10', 90#.
- 1-2000 gal. Horizontal 304 S.S. Tank 5' x 12'.
- 1-2500 gal. Vertical 304 S.S. Tank 8' x 7'.
- 1-10,000 gal. Rubber Lined Tank 10' x 17'6"
- -5500 gal. 316 S.S. Clad Pressure Tank 250 PSI.
- 2-3000 gal. Aluminum Tanks, 7' x 11'.
- 5-25,000 gal. Aluminum Storage Tanks.

MISCELLANEOUS

- 3-Kinney Vacuum Pumps, 1000 cfm, 10 microns, 15 HP.
- 3—Hardinge 6' x 36". 5' x 22" steel lined conical Ball Mills.
- -Sturtevant 6' dia. Air Separator 10 HP.
- 1-Komarek Greaves Briquetting Press 31/2" face rolls.
- 3-Mikro Pulverizers, 1SH, 1SI and Ban-
- 3—Swenson Walker Continuous Crystal-lizers, 24" x 30' sections.
- 2-Tyler Hummer 3' x 10' Double Deck Screens.
- 5-Day Roball Sifters, 40" x 120", 40" x 84". Double Deck.
- 6-Nash H6, H5, L5 Vacuum Pumps.
- 3-Nash H6, L3 347 S.S. Vacuum Pumps.
- 2-Stokes Rotary Tablet Machines DD2-DDS2.

Partial List of Values—Send for Complete Circular

BRILL EQUIPMENT COMPANY

35-61 JABEZ ST., NEWARK 5, N. J. Tel: MArket 3-7420-N. Y. Tel: RE 2-0820 TEXAS OFFICE: 4101 San Jacinto St., Houston 4, Texas—Tel: JAckson 6-1351

SEASON'S GREETINGS from the ENTIRE JIRST MACHINERY and JALCON STAFF

SEND FOR FMC'S NEW 1962 COMPACT CATALOG CHEMICAL EQUIPMENT

AFTER YOU TAKE INVENTORY * SEND US YOUR LIST OF SURPLUS EQUIPMENT—OPEN TO BUY COMPLETE DEPTS.

Vacuum Shelf Dryers by Devine and Buffalo up to 86" x 78"

New FALCON Double Ribbon Blenders in Stainless or Steel; all sizes stocked

Fitzpatrick Comminutating Machines; Models C, D, and K in Stainless

Bird Continuous Centrifugal Filter in Stainless.

Sharples C 27 Super-D-Hydrator in Type 316 Stainless; 40 HP

Buflovac Rotary Vacuum Dryer 3'x7'6" in Type 316 Stainless

Plastic & Rubber Equipment; Mills, Calenders, Extruders, Pelletizers

Rotex and Roball Sifters-Screens Single & Multiple Deck to 120"

Baker Perkins Double Arm Jacketed Mixers from 2 Gal. to 300 Gal.

Stainless Steel Packed Columns; 8" x 10' and 12" x 15

Stainless Steel Reactors from 60 Gal. to 2000 Gal. Jktd. Agtd.

Shriver and Sperry Ni-Resist and Stainless Filter Presses to 30'

Porcelain Lined and Buhrstone Pebble Mills up

A. O. Smith Pressure Tanks, Stainless Lined 10' x 18' with agitators

Mikro Pulverizers, all types in size from Bantam to No. 4's

Buffalo Stainless Thermo-Compression Evaporator, complete

Nickel Clad Reactor 7' x 11'6"; Jacketed-Agitated; Manhole Top

S. S. Lined Rotary Dryer 50" x 20', Counter Current with Accessories

Oliver Pre-Coat Rotary Vacuum Filters; Acid Resistant to 8' x 10'

Link Belt Roto Louvre Dryer Model No. 502-20 complete

SEND FOR SPECIAL BULLETINS ON LIQUIDATIONS CINCINNATI-TOMS RIVER CHEMICAL CO. IN CINCINNATI CEMENT MILL MACHINERY IN TENNESSEE

FIRST MACHINERY CORP.

209-289 TENTH STREET, BROOKLYN 15, N. Y.

FMC Pays MORE For Your Surplus PARKING ON THE PREMISES Phone: STerling 8-4672 Cable Address: "EFFEMCY"



CIRCLE O ON READER SERVICE

2 Autoclaves, Jac.-5' x 18' Baker Perkins—100 gal—50 HP, S.S.-2 arm jac.-vacuum hdr. tilt

Aluminum Evaporator Calandria type— never used—1300 sq. ft. tube area Nickel Heat Exchanger 250 sq. ft. 2 Blenders-Conical S.S.-24", 30"

1 Steel Blender—70 Cu. ft. Distillation Unit S.S. type 316-1200 gal.

per hr. Hydraulic Pumps & Motors

MACHINECRAFT CORPORATION

800 Wilson Ave. (East of Doremus) Newark 5, N. J.

CIRCLE P ON READER SERVICE CARD

BUY ON TERMS!

2-PFAUDLER REACTORS

Model R high pressure 750 gallon, glass lined Reactors. With turbine agitators, adjustable baffles and drives. Perfect

Immediately Available

MACHINERY AND EQUIPMENT CO.

123 Townsend St. - San Francisco 7, Calif

CIRCLE Q ON READER SERVICE CARD

Due to change in methods, have available—one Niagara Batch Miser size 18-18-S Horizontal Plate Filter complete with 18 plates, hand wheels, new spacer to replace nine plates for small Batch Filtering, 2 years old, Also one Shriver 24" x 24" 4 Eye Filter Press 18 plates and frames with Hydrokloser and metal screens. Both in perfect condition, Best offer. No Dealers. Write or Call

FARNOW, INC. 4-83 48th Ave., Long Island City, N. Y. ST 6-1144

CIRCLE AA ON READER SERVICE CARD

Mr. Used Equipment Dealer.

When you advertise in the Searchlight Section . . . You have hired your most persuasive salesman:

He's efficient . . . He thrives on long hours . . . His territory is the entire nation . . . and overseas . . . He doesn't see buyers of used and new surplus equipment: They see him -regularly. They depend on him.

He is Searchlight-The section of this publication where wise dealers advertise and list their stocks for

SEARCHLIGHT SECTION

Classified Advertising Div. Post Office Box 12 New York 36, N. Y.

Сн

VΙ

TO ALL OUR FRIENDS IN THE CHEMICAL-PROCESS INDUSTRIES— Seasons Greetings — Happy New Year!

DRYERS - KILNS

- 1-Buflovak 2' x 7'-10" T304 SS rot. vac. dryer, ASME, jktd., Agit.

 -Buflovak 42" x 120" double drum
- dryers, ASME 160# WP.
- American 42" x 120" dbl. drum.

ml.

34

D

ARD

ARD

CARD

- -American 36" x 52" dbl. drum.
 -Buflovak 42" x 90" dbl. drum.
 -Buflovak 32" x 52" dbl. drum.
 -American 36" x 84" dbu drum.
 -American 36" x 84" double drum
 dryer, ASME, VACUUM.
- Buflovak 5' x 12', single drum dryer, Vacuum, UNUSED.
- Buflovak 6" x 8" dbl. drum.
- -Stokes 195 sq. ft. vac. shelf dryers. -Nerco-Niro stainless spray dryer.
- -10' x 11' x 175' Vulcan kiln.
- -10' x 100' rotary dryers, 56" welded
- shell, complete. 2-B. & Snow 8'-6" x 70' rotary dryers,
- welded shell, late model. 2-8' x 125' rotary kilns, 5%" shell.
- -7'6" x 62" rotary kiln, 1/2".
- 1-6' x 150' rotary kiln, 5%" welded.
- Louisville 5' x 30' steam-tube. Louisville 4'-6" x 25' rotary steam-
- tube dryers, welded.
- -Bartlett & Snow 3' x 15' rotary dryer. Everdur metal shell.
- 1-3' x 23' rotary, 1/4" welded.

STAINLESS STEEL TANKS

(T304 UNLESS NOTED)

- -20,000 gal., 14' x 15'. T316LC, cone
- -13.000 gal. 11'10" x 15'7" 1-12,000 gal 9'-6" x 22', T304 SS.
- horiz., dished-UNUSED.
- -5700 gal. horiz., 6'-4" x 24', UNUSED. 4500 gal. vert., 8' x 12', UNUSED.
- -3650 gal. 10' x 7', vert., open. -3350 gal., 8'x8'6", agit., 50 psi.
- -3300 gal. 6' x 14'-6", vert. -3250 gal., 6' x 15', T316.
- -3000 gal., 8' x 8', T316 SS, Vert.
- -3000 gal. 8' x 8' vert.—UNUSED.
- -2800 gal., 5' x 18', dished. -2600 gal., 7' x 8', T316 dished.
- -2250 gal., 8' x 6', T316, coils
- -2100 gal., 8' x 5'6", dished. -2100 gal., 6' x 9', T316, cone.
- 12—1750 gal., hoppers, 4'-5" x 7'-4" x 9'-2".
- 4—1350 gal., 4' x 14', T347, dished, ASME 60 psi coils.
- —1350 gal., 7' x 4'-6", T321. —1300 gal., 6' x 6', 3%", dished.
- -1100 gal., 4' x 11', T347, 60 psi. -1000 gal., 4'-6" x 8'-6", dished.
- -850 gal., 4' x 9', 3/8", dished.
- -800 gal., 5'x5'6", 1/4", dished.
- 3-750 gal., 5' x 5', 3/16", dished.
- 6-685 gal., 3' x 13', T316, coils.
- 3-300 gal., 4' x 3', T347, 60 psi.

KETTLES—REACTORS

- 1-2000 gal. Glascote blue G/L reactor. 40-1400 gal. Pfaudler blue G/L ikt. ket-
- tles, Agit., baffles. 3-1350 gal. T347 SS kettles, open top.
- 13-1250 gal. Plaudler blue G/L ikt. reactors. Agit.
- 1-1200 gal. Artisan T304 SS reactor, vac. int., 100 psi jkt., Agit.
- -1000 gal. T316 SS jacketed reactor. ASME, UNUSED.
- 1-1000 gal. Dopp cast iron kettle, 125#
- jacket, 15# int., Agit. 1-750 gal. Graver T304 SS jkt. fermenter, ASME Agit.
- 1-750 gal. Pfaudler glassed jkt. kettle.
- 3-500 gal. Pfaudler "R" glassed jacketed reactors, Agit.
- 50-600 gal. Plaudler Stainless jacketed kettles, open.
- -500 gal. T316 SS jacketed reactor.
- -500 gal. T304 SS reactors, jacketed, ASME, Vacuum-Unused.
- 465 gal. T304L SS reactors, jacketed, 150# int., 175# jkt.
 - -300 gal. T316 SS ikt. kettle, Agit. -300 gal. T304 St jacketed reactor,
 - vac. ASME-UNUSED.
- -300 gal. Pfaudler blue G/L reactor, Agit., jkt., ASME.
- -200 gal. T304 SS jkt. reactors, ASME, UNUSED.
- 1-175 gal. T304 SS jkt. reactor.
- -150 gal. Pfaudler "P" glassed reactor, jacketed, Agit.
- -100 gal. UNUSED T304 SS jacketed reactors, vacuum, ASME.
- -80 gal. T347 SS autoclave, 350 psi WP, 100 psi jkt., Agit.

MIXERS-MILLS

- 25-Baker-Perkins 200 gal. jkt. sigmablade Dbl. Arm Mixers.
- 1-Baker-Perkins 100 gal. dispersion mixer, #15-UUMM, 100 HP drive, jacket, comp. cover, motorized tilt.
- Baker-Perkins 100 gal. disp. mixer, T347 SS, ikt.
- -145 cu. ft. horiz. ribbon mixers.
- -Sturtevant 75 cu. ft. blender, T304
- 1-Worthington 70 cu. ft. rotary blender.
- 12—Abbe Eng. 6' x 8' pebble mills. 3—Hardinge conical pebble mills: 8' x
- 48", 7' x 36". Marcy #641/2 ball mill, 100 HP. Allis-Chalmers 6' x 12' rod mill.
- -Bonnot 5'x10' ball-rod mill, 75 HP.
 -Raymond 66", 6-roller hi-side mill.
 -Raymond 50", 5-roller hi-side mill.
- Fitzpatrick #f Stainless comminutor.
- Forster #8 hammermills, 100 HP.

EVAP.—EXCHANGERS

- 7-4050 sq. ft. calandria type evap., copper tubes, cast iron shell.
- 1-1250 sq. ft. Mojonnier dbl.-effect Stainless Sanitary evaporator.
 Buflovak double-effect stainless evap.,
- vert. long-tube, 840, 710, 588 sq. ft.
- 630 sq. ft. Struthers-Wells T316 SS Calandria evap.
- 320 sq. ft. steel reboiler.
- -250 sq. ft. Buflovak T304 SS, single effect recompression evap.
- 1-118 sq. ft. Stokes T316 SS still.
- 1-36" dia. x 6 plate T316 SS column.
- 2-Vulcan T316 SS 10 plate bubble cap columns: 110", 60" dia.
- -30" x 19' T347 SS packed columns.
- 8-24" x 16' Duriron packed columns.
- 1-24" x 33' Duriron & SS column.
- 1-1960 sq. ft. T316 SS exchanger, remov. bundle, ASME 75# WP.
- -1450 sq. ft. T316 SS condenser.
- 5-1400 sq. ft. T316 SS gas converters.
- 1-900 sq. ft. T304 SS exchanger.
- 3-800 sq. ft. T316 SS condensers.
- 1-730 sq. ft. T316 SS exchanger.
- 6-691 sq. ft. copper dbl. pipe cooler.
- 1-510 sq. ft. T316 SS condenser.
- 8-400 sq. ft. T304 SS pipe coolers. 12-Amer. Heat Reclaiming T316L SS
- spiral exchangers: 162, 73 sq. ft.
- 15-75 sq. ft. nickel pipe coolers. 30—T316 SS heat exchangers & condensers: 425, 400, 290, 277, 200, 165, 150, 142, 105, 73, 54 sq. ft.
- 50-Duriron exchangers & condensers.
- Pfaudler glassed thimble condensers: 62, 47, 15 sq. ft.

STAINLESS PUMPS

Aldrich T316 SS 3-cylinder piston pumps: $3\frac{1}{8}$ " x 5", $2\frac{5}{8}$ " x 3", $1\frac{1}{2}$ " x 2".

Worthington Worthite Cent. Pumps; 4" x 3", 3" x 2", 2" x 11/2", 11/2" x 1", w/motors.

LaBour 2" 316 SS self-priming cent. pumps w/motors. Aurora 11/2" SS sump pumps

STAINLESS PIPE & VALVES

50,000'—T304 SS pipe, sch. 10 & 40, 1" to 6". 20,000'-T304 SS vapor pipe, to 24".

10.000 -T304 & T316 SS flanged valves, to 8".

CORPORATION

1413-21 N. SIXTH ST. PHILADELPHIA 22, PA.

Phone POplar 3-3505

CIRCLE R ON READER SERVICE CARD

FOR "IMPOSSIBLE" BUDGETS

Hersey Dryer, 7' x 30' Rotary hot air. Welded shell. 15 HP motor

Apron Dryer, 36" wide SS belt 98' long. 2,000,000 BTU. Natural Gas Burner

St. Regis Fillers, 1-Model 101 FS, single spout and 107 FC 3 Spout

Patterson-Kelly Twin Shell Blender, 1 cu. ft. 1/2 HP Ex Proof Motor (2)

Raymond 16' Whizzer Air Separator, and Sturtevant 16' Whirlwind Separator

Foster-Wheeler unused Karbate Heat Exchanger. 59 sq. ft.

Sweco 48" Separators; 1—4 deck and 1—2 deck. Each complete

1-Raymond Model 5048 high side Mill w/Whizzer Separator. TEFC mtrs New 1951

For immediate quote, write or phone collect-GA 1-1380



MACHINERY AND EQUIPMENT COMPANY

123 Townsend St. - San Francisco 7, California

CIRCLE S ON READER SERVICE CARD

LIQUIDATIONS

Niagara Falls, N. Y. and Everett, Mass. **EQUIPMENT OFFERINGS**

Baker Perkins 100 gallon MIXER jktd., sigma Baker Perkins 300 gallon Stainless Steel Size 18DIM Sigma Blade MIXER, 30 HP motor 42" Tolhurst CENTRIFUGE Perforate Nash L3 Stainless VACUUM PUMPS 140 CFM (3) 11,500 gal. Stainless TANKS Agitated 48"x41' Vulcan Stainless BUBBLECAP COLUMN 40 trays, 70 caps/tray, 100 PSI design 72"x30' Budd Stainless BUBBLECAP COLUMN

21 trays, 38 caps/tray Pfaudler 500 gal. ELL GLASS LINED REACTOR, agitated, 75 PSI jacket, 25 PSI internal Pfaudler 300 gal. EL GLASS LINED REACTOR, agitated, 90 PSI jacket, 25 PSI internal 8000 gal. Stainless 316 TANKS 10'x14' vertical 4500 gal. 347 Stainless COIL PANS, 6'x20' (2) 5'3"x3' Oliver Precoat Rotary VACUUM FILTER,

Vaporite, 316 Stainless Link Belt 604-24 Stainless ROTO-LOUVRE DRYER 1860 sq. ft. Stainless REBOILER 271-1"x12' tubes 8'x60'x5/8" Allis-Chalmers ROTARY KILN 60"x84" Single deck Rotex #421 SCREEN Swanson EVAPORATOR 435 sq. ft. Stainless,

single effect condenser, vapor separator 1000 gal. Dopp Ni-resist įktd., agit. REACTOR 1000 gal. Steel REACTOR, jacketed & agitated LaBour PUMP 316 STAINLESS 125 GPM @ 211' 500 ft. Glass lined jacketed PIPE 2", 3" and 4" 306 sq. ft. STAINLESS EXCHANGER, 3/4" tubes 36"x20' COLUMN 316 Stainless Packed, 100 PSI 4'x40'x3/8" ROTARY DRYER NEW welded shell 2000# Stainless RIBBON BLENDER 32"x96" LaBour PUMP STAINLESS STEEL 750 GPM @ 80' 4000 gal. Vert. Type 347 TANK

6'x36" Hardinge CONICAL BALL MILL, 75 HP Buflovak 6' jacketed vacuum CRYSTALLIZER 1000 sq. ft. STAINLESS EXCHANGER, 34" tubes 10'x150' ROTARY KILN complete

78"x18' STAINLESS 316 BUBBLECAP COLUMN 14 trays, 180 caps/tray, 100 PSI 12"x18" STAINLESS PACKED COLUMN, 100 PSI 8'x150' ROTARY KILNS complete (2) 8'x90' ROTARY DRYER complete 3,500 gal. 304 Stainless TANKS 8'x9' Vertical 2,300 sq. ft. Stainless EXCHANGER, 1" tubes 16"x10'7" Pfaudler GLASS LINED SCRUBBER

COLUMN 25 PSI and full vacuum Swenson Stainless Jkt. CRYSTALLIZERS 24"x20"

Write for cataloas

HEAT & POWER CO. INC.

60 E. 42nd Street, New York 17, N. Y. MU 7-5280 310 Thompson Bldg., Tulsa 3, Okla. LU 3-4890

CIRCLE T ON READER SERVICE CARD

BOILERS-500 HP-150 PSI-package gas/oil-New late 1957

CRYSTALIZER-482 cu. ft.-316 s/s Struthers Wells "Krystalizer"

FILTERS—string discharge 8' x 8' FEINC—Rubber covered 4'6" x 8' FEINC-Rubber covered.

VACUUM RCVRS .- 7'6" dia. x 9' deep-rubber line-w/Schutting & Koerting Jet vacuum pumps.

MIXING TANK-5800 gal. Neoprene lined w/motorized Agitator.

LAWLER COMPANY

Durham Ave. Liberty 9-0245 Metuchen, N. J.

CIRCLE U ON READER SERVICE CARD

SPECIALS

SPECIALS

Steam Generator: Clayton 100 hp. 100 #WP.
3-roll Mill: Day 10 × 22" high speed 2-speed.
3-roll Mill: Lehmann 12x32" high speed 25 hp.
Pebble Mills: Abbe #3, #6, and others.
Dryer: Bowen lab. spray, st. st.
Evaporator: Buflovak, sgl. eff, st. st. 94 sq. ft.
Dryer: Powen lab. spray, st. st.
Evaporator: Buflovak, sgl. eff, st. st. 94 sq. ft.
Dryer: Porter 2 × 4" vac. drum, st. st.
Centrifugal: Tolhurst 26" rubber 2-speed.
Filter: Sweetland #5 st. st. lined.
Filter: Oliver precoat 12 × 2" type 316 st. st.
Kettles: Stainless Steel—Send for our list.
Dryer: Protor & Schwartz 6-tray st. st.
Powder Mixers: Day Jumbo 120 cv. ft.
Write us or call Seeley 8-1431

Write us or call Seeley 8-1431 Send us a list of your idle machine OEB EQUIPMENT SUPPLY CO.
818 W. Superior St., Chicago 22, III.

CIRCLE V ON READER SERVICE CARD

COMPRESSORS

No better values at any price
65 CFM 600 PSI 5%-2-2/x5 Gardner ABD
130 CFM 100 PSI 7x, 1ng. ES. CP & Joy
288 CFM 100 PSI 9x9 1ng. Worth. CP
288 CFM 100 PSI 9x9 1ng. Worth. CP
321 CFM 129 PSI 10x1 11R. CP. Worth
445 CFM 125 PSI 10x1 11R. CP. Worth
446 CFM 125 PSI 10x1 11R. CP. Worth
450 CFM 125 PSI 10x1 11R. CP. Worth
450 CFM 125 PSI 10x1 11R. CP. Worth
450 CFM 125 PSI 12x1 1-1R. ES CP.T. Worth HB
520 CFM 100 PSI 12x1 1-1R. ES CP.T. Worth HB
520 CFM 110 PSI 15x1 3 Worth HB XBB 3-60-440
686 CFM 110 PSI 15x1 3 Ing. ES Gardner
1055 CFM 100 PSI 13x1 1 ng. ES Gardner
1055 CFM 100 PSI 13x1 1 ng. ES Gardner
1055 CFM (actual) 125 PSI C300-300H Fuller 350
HP Syn 3-60-440 .8 PF
2200 CFM 100 PSI 26-15x28 Ch. Pn. occ 350-HP
330-64500.3 PF
2230 CFM 110 PSI 25-15x12 Ing. Rand XVH
350 HP GE Syn. 3-60-440

AMERICAN AIR COMPRESSOR CORP. No better values at any price

AMERICAN AIR COMPRESSOR CORP. Chem. Road, North Bergen, N.J. UNion 5-1397

CIRCLE W ON READER SERVICE CARD

OCOMOTIVE—RR CARS & CRANES
9 Gen. Elec. 20, 25, 45, 65, 70, 80, 100, 125 Ton
25-Ton Industrial Brownhoist 60' Boom Crane
200—50 Ton Box 300—70 Ton Gondola Cars
300—1/2, 5, 2, 20 & 30 yd Dump Cars

200—30 I on 50 30—01 on Gondoi Cars
300—1½, 5, 20 & 30 yd Dump Cars
PLANT EQUIPMENT
2—Wemco 2M-HMS Plants
12" Traylor Gyratory Crusher
No. 1—Sturtevant Hammer Bar Mill
No. 2 Robins Vertical Cone Crusher
24" x 24" [5ffrey Single Roll Crusher
No. 1 Sturtevant Rotary Fine Reduction Crusher
S' x 8" & 4" x 9" KYS Air Swept Ball Type Mills
14" x 14" x 15" x 15" x 15" x 15" x 12" x 15" x

Crusher's Roll: 2½" x 14", 30" x 14", 40" x 15"
5' x 30" Ruggles Coles Double Shell Rotary Dryer
Complete
Rotary Dryers: 5' x 30', 6' x 50', 6' x 70' & 8' x 80'
Rotary Kilns: 6' x 70', 7' x 110' & 9' x 160'
2-13" x 120" Buflows Armos, Double Drum Dryer
2-13" x 120" Buflows Armos, Double Drum Dryer
150—1½, 2 & 4 vd. & 30 vd Dump Cars
150—1½, 2 & 4 vd. & 30 vd Dump Cars
400 CFM 32" Dings Magnetic Head Pulleys
690, 2200', 3068' & 3600-7500' IR. Compressors
1100 CFM Siy Dust Collector
WANT BUY DRYERS—KILNS—CRUSHERS
C. Standard Lar. 60 E 42 5t., N. Y. 17, N.Y.

R. C. Stanhope, Inc., 60 E. 42 St., N. Y. 17, N.Y. Tel. MU 2-3075 or MU 2-1898

CIRCLE X ON READER SERVICE CARD

\$34 MILLION PLANT LIQUIDATION

OKLAHOMA ORDNANCE WORKS PRYOR, OKLAHOMA

COMPLETE UNITS EQUIPMENT—BUILDINGS for use in place or removal

10,000 Acres With All Utilities For Industrial Plants

> Lowest Gas-Electricity & Water Rates

> > **Excellent Effluent** Disposal Areas

Plants For Use In Place

. NITRIC ACID DIMETHYLANALINE

AMMONIA

OXIDATION . TETRYL

• NITRO CELLULOSE · ALCOHOL

. FTHER

 DIPHENYLAMINE • SELLITE

. SULPHURIC ACID CONCENTRATING

This plant was put in excellent stand-by condition by the Government. All equipment is ready to go back into service, now!

Leasing or Financing Available For Complete Units In Place or Individual Equipment

Catalog being prepared. Write for your copy.

HEAT & POWER CO. INC.

60 E. 42nd Street, New York 17, N. Y. MU 7-5280 310 Thompson Bldg., Tulsa 3, Okla. LU 3-4890

CIRCLE Y ON READER SERVICE CARD

Cı

МΙ

Hold down your overhead with CHEMICAL PROCESS EQUIPMENT

-Cowles type 316 SS dissolver, Model 20D with 20 HP explosion proof motor -Sparkler SS horizontal filter, Model 33-D-7

-SS 11,000 gals. vertical storage tanks -Buflovak 6" x 8" chrome plated double drum dryer,

AUTOCLAVES, KETTLES, REACTORS, TANKS

- 3-Glascote Model HR 1500 gal. glass lined jacketed reactors, complete with impeller type agitators, baffles and drives
- Pfaudler Series R 1500 gal. glass lined jacketed reactor, complete with impeller type agitator, baffle and drive
- Pfaudler 750 gal. glass lined jacketed reactor

- 1—Glascote 750 gal. glass lined jacketed vacuum receiver 1—Pfaudler type 316 SS 750 gal. reactor 72—Alloy Fabricators 400 gal. SS jacketed reactors complete with agitators and drives
- 2-Pfaudler Series EM glass lined jacketed reactors complete with agitators and drives, 400 and 300 gals.
- Pfaudler type 316 SS jacketed reactors, 200 and 100 gals. Struthers Wells 300 gal. Hastelloy "B" jacketed kettle
- Blaw Knox 300 gal. SS vacuum reactor
- -Van Alst 300 gal. SS jacketed kettle
- –125 gal. SS jacketed autoclave with impeller type agitator and drive, 125 psi jacket, 75 psi internal –Vertical SS storage tanks, 12,500 gals.
- -2000 gal. SS storage tank
- 10-Plaudler Series P glass lined jacketed reactors, 20, 30, 50 and 100 gals.

CENTRIFUGES

er Mills

24".

¥ 7'

Drver x 80

ssare

CARD

T

RKS

al

JLOSE

NINE

nd-by ment

ble

opy.

5280 4890

ARD

ING

G

- 2-Sharples type 316 SS nozljectors with 40 HP explosion proof
- -AT&M rubber covered suspended type centrifuge with 36" perforate basket, motor and plow Merco SS centrifuge, Model C-9
- Baker Perkins SS Termeer centrifuge, Model HS-24, complete
- -AT&M 26" type 316 SS suspended type centrifuge -AT&M 12" SS suspended type centrifuges
- -Bird SS 40" suspended type centrifuge complete with perforate basket, plow and motor

- Sharples type 316 SS centrifuges, Model D-2

 -Tolhurst 40" x 30" rubber covered centrifuges

 -Western States type 316 SS 40" suspended type centrifuges, complete with perforate baskets, plows and motors

- 1—Bartlett & Snow rotary dryer, 3' x 16', complete—NEW 17—Stokes type 304 SS jacketed rotary vacuum dryers, 3' x 10' and 3' x 15'

 Stokes SS jacketed rotary vacuum dryer, 2' x 6'

 ADT SS lined rotary steam tube dryers, 42" x 30' long

- 10—Allis Chalmers rotary dryers, 6' x 50' and 7' x 60'
 1—Allis Chalmers SS rotary dryer, 6' x 50'
 1—American 42" x 120" double drum dryer, ASME, complete
- -Buflovak SS jacketed rotary vacuum dryer, 5' x 30'
- Buflovak steel jacketed rotary dryer, 3' x 15'
- Louisville 8' x 50' SS rotary dryers
- -Link Belt steel roto louver dryer, Model 207-10 -Link Belt steel roto louver dryer, Model 502-20
- SS pilot plant spray dryers



THE GELB GIRL - DECEMBER 1961

FILTERS

- -Niagara SS filter, Model 510-28
- Niagara SS jacketed filter, Model 33-12-D
- Sperry 36" x 36" rubber covered filter presses, 27 chambers
- 10-Shriver plate and frame filter presses, 12" to 42"
- 12—Sweetland #12 pressure leaf filters with 72 stainless leaves

- 15-SS double cone jacketed vacuum blenders, 10 cu. ft.
- -SS horizontal double ribbon jacketed blenders, 62 cu. ft.
- Young SS double ribbon blender, 4 cu. ft., complete
- Baker Perkins 150 gal. dispersion type mixer, complete
- -J. H. Day 200 gal. SS double arm sigma blade jacketed mixer
- -J. H. Day 5 gal. double arm sigma blade jacketed mixer, SS
- 15—Robinson type 304 SS horizontal blenders, 255 cu. .ft. 1—Robinson type 304 SS horizontal blender, 125 cu. ft.
- Sprout Waldron 30 cu. ft. jacketed ribbon blenders, steel Stokes SS granulating mixer, Model 21-J Sturtevant #7 dustite rotary batch blender—NEW

- 18-Davis Engineering heat exchangers, SS, 115, 134, 156 and 208 sq. ft.-NEW
- -Worthington and Durimet centrifugal pumps, 4×3 , 3×2 , 2 x 11/2, etc.
 - -Badger SS heat exchangers, 500 and 600 sq. ft.
 - Patterson SS condensers, 200 and 300 sq. ft.
 - Plaudler glass lined thimble type condensers, 9, 14, and 62
 - -Patterson-Kelley Carpenter 20 heat exchanger, 520 sq. ft.
 - Struthers Wells SS 1150 sq. ft. single effect evaporator
- -Cleaver Brooks package steam generators, 150 HP and 500 HP, 160 psi
- Superior 300 HP package steam generator, 125 psi Raymond 2 roll high side mill
- Williams "Comet" 4 roll mill, complete
- Sprout Waldron pelletizer, Type 501 FF
- Mikro #3TH SS pulverizers
- Mikro Bantam pulverizers
- -Vulcan SS bubble cap column, 4' dia. x 25 plates
- Stokes rotary tablet press, Model RDS-3
- -Alloy Fabricators 5000 gal. jacketed reactor, complete with agitator and drive
- -Eimco SS rotary vacuum filter, 4' x 4' -Stokes type 304 SS jacketed rotary vacuum dryers, 3' x 10', 3' x 15'
- -Glascote Model HR 2000 gal. glass lined jacketed reactors, complete with impeller type agitators, baffles



U. S. HIGHWAY 22, UNION, N. J. MURDOCK 6-4900

& SONS, INC.

CIRCLE Z ON READER SERVICE CARD

how to cultivate taste

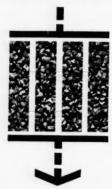


You can't sweet-talk contaminated gas out of your product or process. Soda water, hydrogenated foods and dry ice producers learned long ago that activated carbon gas purification is an essential step in producing a palatable product. How clean are your bubbles?

how to paint out the smell

Filters, fabrics and containers do double duty when coated with activated charcoal paint. Sprayed or brushed on it adsorbs odors instead of producing them. Can be washed off after saturation. Try a quart or a tank car.

activated carbon



We supply a complete line of activated carbons for every purpose; design and prefabricate complete purification, separation, and recovery systems to meet your particular needs. Write for Bulletin J-122, and recommendations on your specific application. Barnebey-Cheney, Columbus 19, Ohio.

Barnebey Cheney

Index to Advertisers

Aerofin Corporation	153
Barneby-Cheney Co	170 150 59 2 31 51 105
Cambridge Wire Cloth Co	65 64 18
Dahl Co., G. W. Darling Valve & Mfg. Co. Davenport Machine & Foundry Co. Day Co., J. H. Dow Corning Corp. Downington Iron Works, Inc. Duriron Company, Inc. DuVerre, Inc.	160 107 160 115 99 4 109 152
Entoleter, Inc., Subsidiary of American Manufacturing Co	123
Foxboro Co	117
Garlock, Inc	101
Co., (Turbo Mixers)	29 33
Ingersoll-Rand Co12	2-13
Jeffrey Manufacturing Co Jenkins Bros.	56 35
Kendall Company Polyken Products	53
Link-Belt Co	16
Manton Gaulin Mfg. Co Minneapolis-Honeywell20-21,	83 39

Advertising Sales Representatives

Atlanta 9
13/3 Peachtree St., N. E., Ikinity 3-0323
Boston 16A. S. Reed
Boston 16
COngress 2-1160
Chicago 11 Gene Davis. Harvey Dunn
AAE NI Michigan Aug MOhault A 5000
645 N. Michigan Ave. MOhawk 4-5800 Cleveland 13John C. Mitchell
Cleveland 13John C. Mitchell
55 Public Square SUperior 1-7000 Dallas 1 F. E. LeBeau Vaughn Bldg., 1712 Commerce
Dallas 1
Vaughn Bldg. 1712 Commerce
Danuar 2
Denver 2John Patten
1700 Broadway Alpine 5-2981
Denver 2 John Patten 1700 Broadway Alpine 5-2981 Detroit 26 Chas. M. Crowe, Jr.
856 Penobscot Bldg. WOodward 2-1793
Frankfurt/MainStan Kimes
85 Westendstrasse
Geneva Michael R. Zeynel
Geneva
2 Place du Port
Houston 25 J. C. Page
W-724 Prudential Bldg. JAckson 6-1281
Houston 25J. C. Page W-724 Prudential Bldg. JAckson 6-1281 London W. 1. E. S. Schirmer, Edwin E. Murphy
34 Dover St.
Les Angeles 17 John O Habaff
34 Dover St. Los Angeles 17John B. Uphoff 1125 W. Sixth St. HUntley 2-5450
New York 36 R. G. Frederick, A. L. Gregory,
Johnson C. Blake
500 Fifth Ave. OXford 5-5959
New York 36. R. G. Frederick, A. L. Gregory, Johnson C. Blake 500 Fifth Ave. Philadelphia 3 M. A. Loy, Jr., L. D. Zerone 6 Penn Center Plaza LOcus 8-4330
4 Done Contes Disease 10-11 0 4220
Pittsburgh 22
rinsburgh 22
4 Gateway Center EXpress 1-1314
Portland 4Scott B. Hubbard
Room 445, Pacific Bldg. CApitol 3-5118
St. Louis 3
7751 Carondelet Ave. PArkview 5-7285
PARKVIEW 3-/203
San Francisco 11John Hernan
255 California St. DOuglas 2-4600

Minnesota Mining & Mfg. Co Mixing Equipment CoFourth C	120 over
National Carbon Co., Div. of Union Carbide Corp. National Engineering Co National Filter Media Corp. Neptune Meter Co NETTCO Corporation Niagara Blower Corp.	91 63 154 157 124 162
Owens-Illinois Sub.—Kimble Glass Co	57
Pfaudler Co., Division of Pfaudler-Permutit, Inc. 1 Phelps Dodge Copper Products Corp	4-15 4-55
Pittsburgh Corning Corp	103
Quaker Oats Co. (Chemical Div.)	37
Renneburgh & Sons, Edw. Rockwell Manufacturing Co. Nordstrom Valve Div Rockwood Sprinkler Co.	
Ball Valves Portable Division Rohm & Haas	149 23 121
Sarco Company	93
Selas Corporation of America Shell Oil Co. 46 Snam 9 Solar, a Subsidiary of	122 6-47 6-C
International Harvester Corp	155
Standard Steel Corp	125
Strahman Valves, Inc	125
Sturtevant Mill Co	119 6-A
Standard Steel Corp. Stokes Corp., F. J. Strahman Valves, Inc. Sturtevant Mill Co. Sulzer Bros., Ltd. Sun Shipbuilding & Dry Dock Co. Surface Combustion, Div. of Kathabar Corp.	113
Kathabar Corp	
U. S. Steel Corp. American Bridge Div10	-11
Vogt Machine Co., Henry	66
Wallace & Tiernan, Inc158,	159
	159 161 97 114 151 ever ever 6-B
Wallace & Tiernan, Inc	159 161 97 114 151 over 6-B 41
Wallace & Tiernan. Inc	159 161 97 114 151 over 6-B 41
Wallace & Tiernan, Inc	159 161 97 114 151 ever 6-B 41
Wallace & Tiernan. Inc	159 161 97 114 151 wer wer 5-B 41 163
Wallace & Tiernan. Inc	159 161 97 114 151 ever ever 6-B 41 163 163 164 164
Wallace & Tiernan, Inc	159 161 97 114 151 ever 6-B 41 163 164 164 164
Wallace & Tiernan, Inc	159 161 97 114 151 ever 6-B 41 163 164 164 164
Wallace & Tiernan, Inc	159 161 97 114 151 wer 6-B 41 163 164 164 164
Wallace & Tiernan, Inc	159 161 97 114 151 ver ver 6-B 41 163 164 164 164
Wallace & Tiernan, Inc	159 161 97 114 151 151 41 163 163 164 164 169
Wallace & Tiernan, Inc	159 161 97 114 151 151 163 163 164 164 164 165 164 165 164 165
Wallace & Tiernan, Inc	159 161 97 114 151 163 163 164 164 164 165 164 165 164 165 164 165 164 165 164 165 164 165 164 165 164 165 164 165
Wallace & Tiernan, Inc	159 161 97 114 151 163 163 164 164 165 168 164 165 164 165 164 165 164 165 164 165 164 165 164 165 165 166 166 166 166 166 166 166 166
Wallace & Tiernan, Inc	159 161 97 114 151 163 163 164 164 164 165 164 165 164 164 165 164 164 164 165 164 164 164 165 164 164 165 164 164 165 164 165 165 165 165 165 165 165 165 165 165
Wallace & Tiernan, Inc	159 161 97 114 151 151 163 163 164 164 164 164 164 164 164 164 164 164
Wallace & Tiernan, Inc	159 161 97 114 151 163 163 164 164 164 165 164 164 164 164 164 164 164 164 164 164
Wallace & Tiernan, Inc	159 161 97 114 151 yer 41 163 163 164 164 165 166 169 168 168 168 168 168 168 168 168 168 168
Wallace & Tiernan, Inc	159 161 977 114 151 163 163 164 164 166 166 166 166 166 166 166 166
Wallace & Tiernan, Inc	159 161 97 114 151 151 163 164 164 164 164 164 164 164 164 164 164
Wallace & Tiernan, Inc	159 161 97 114 151 151 163 164 164 165 165 165 166 167 168 168 167 168 168 167 168 168 167 168 168 167 168 168 168 168 168 168 168 168 168 168

The VITAL Link IN YOUR PRODUCTION CHAIN

-15

-55

-C

Downtime slows production or stops it entirely. Eliminate expensive shutdowns by installing Wilfley Acid Pumps.

Dependable, maintenance—free performance has become synonymous with the name Wilfley. Year after year, in countries throughout the world, Wilfley Acid Pumps operate continuously without attention, providing lower pumping costs in every installation.

When you are pumping corrosives, hot liquids, or mild abrasives, there's a dependable Wilfley Acid Pump to do the job for you. Pumping parts are available in a variety of metal alloys as well as plastic.

1" to 8" discharge sizes with 10 to 3000 GPM capacities, heads to 200' and higher.

EVERY INSTALLATION IS JOB ENGINEERED

WILFLEY

Willey Sand Pumps
"Companions in Economical Operation"
Willey Acid Pumps

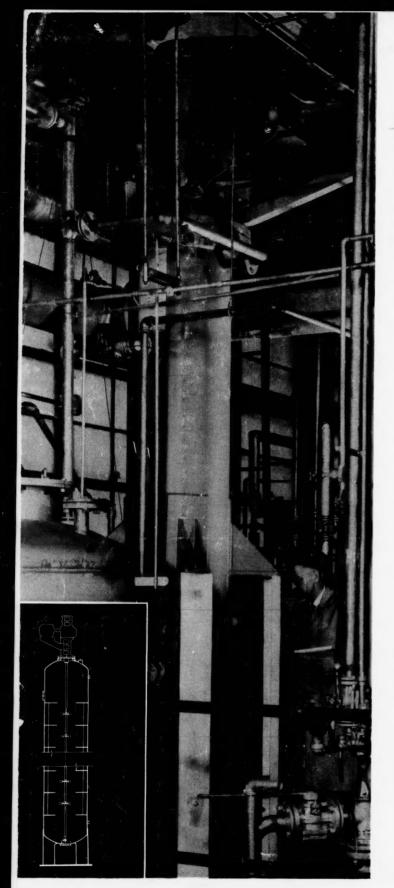
Write, Wire or Phone for complete details.

A. R. WILFLEY and SONS, Inc.

Denver, Colorado, U.S.A. • P.O. Box 2330

New York Office: 122 East 42nd St., New York City 17, N.Y.





CMCONTACTOR can be pilot plant size or as large and as high as needed. Corrosion-resistant materials are readily supplied. Here a CMContactor reclaims a chemical from process liquor at photo chemicals division of Eastman Kodak Company.

LIGHTNIN CMCONTACTOR

new multi-stage mixing column handles anything that flows

Don't freeze your plans for "going continuous" a process until you've had a chance to see what the new LIGHTNIN CMContactor can do for you.

In one package it combines mixer and processes, designed to fit your needs, in materials of your choice. It can accommodate any fluids, in cluding gas dispersions, heavy slurries, and this viscous liquids.

It handles any type of continuous operation. An it gives you predictable results.

Here's why you'll find you can get results wit the CMContactor that you can't get any other way

- No fouling or plugging. Simple, self-cleaning design makes it possible to handle fluids of high solids content. Solids can be carried through with the flow stream, settled against the liquid flow current, or retained in the column
- 2. No guessing when you scale up. Fully baffle system means a controlled flow pattern within each stage, free from problems of channeling wall effects, packing wettability, and head differentials. Pilot plant conditions can be duplicated with precision in columns of any size.
- Selected mixer speed for each flow rate. As flow rate changes, mixer speed can be adjusted to give optimum performance for that specific throughput.

We help you pilot-plant the process. We'll test-runi for you in our own laboratory. Or you can rent o buy a pilot CMContactor and we'll help you with your own test runs.

To get a fuller idea of the efficiency this versatilenew process tool can bring to your operations call in your LIGHTNIN Mixer representative now He's listed in Chemical Engineering Catalog and in the yellow pages of your telephone book. Owrite us direct.

3.2 84

Lightnin Mixers.

MIXING EQUIPMENT Co., Inc., 128-n Mt. Read Blvd., Rochester 3, M.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 19, Ont.

In Europe: Lightnin Mixers, Ltd., Poynton, Cheshire, England.

A*CTOR* Dlum flows

uous" of what the ou.

l proces terials o uids, in and thick

ion. An

ults with ther way cleaning fluids o

fluids o carrie ainst the column

y baffle n within nneling nead dif be dupli size.

As flow usted to specific

est-runi n rent o ou with

versatile erations ve now log and ook. O

ester 3, IL.I a Ave.,

gland.